TECHNOLOGY DEPT

POWER

JULY 1946

GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES

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JUL 15 1946
DETROIT

Firing coke breeze on traveling-grate stokers, three modern boilers, one a spare, replace nine old hand-fired units. Substitution of byproduct fuel for high-grade coke, which had a ready local market, cut steam cost. For the story, see page 64

◀ *V-2 power plant being readied for test—for on-the-spot report with new details, turn to page 79*

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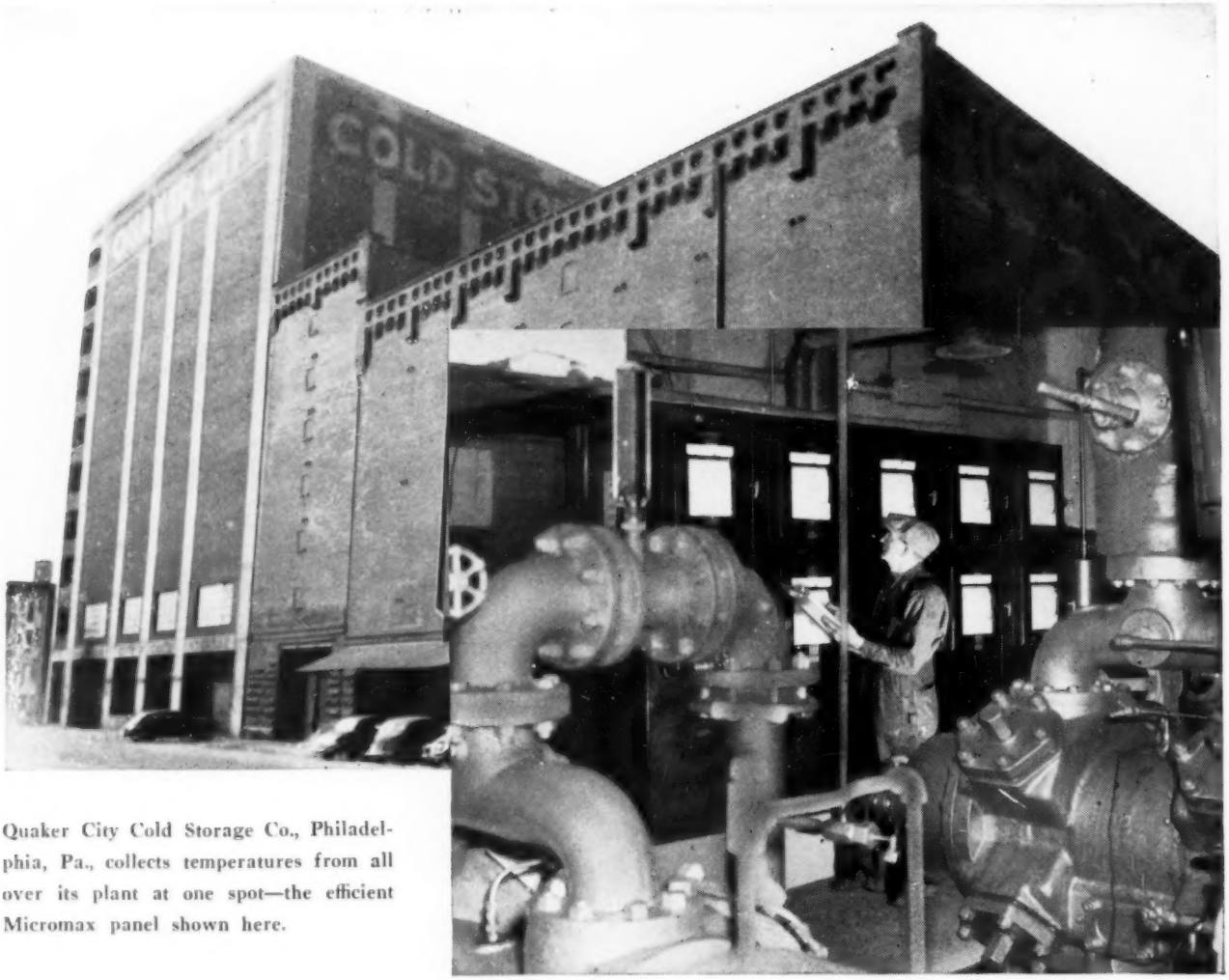
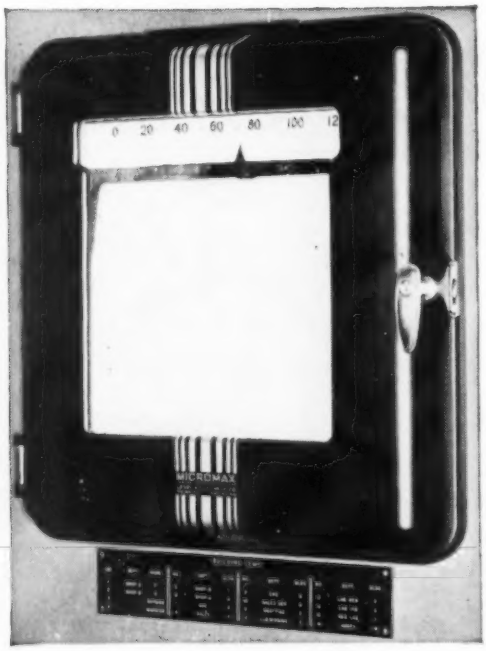


Quaker City Cold Storage Co., Philadelphia, Pa., collects temperatures from all over its plant at one spot—the efficient Micromax panel shown here.

Big Building Saves Big Sums with Micromax Temperature Recorders



Typical Micromax Recorder, mounted on panel, for providing accurate information about building temperatures

The daily miles of walking required to read temperatures in the big Quaker City building shrank to a few yards when Micromax instruments centralized the job of temperature recording. And this is just one reason why Micromax saves time, effort and money for efficiency-minded building managers. Along with the reduction in labor, temperature changes are reported more quickly and therefore corrected more promptly. This gives not only a substantial saving in power, but also a smoother temperature curve for each building area.

Micromax instruments are fitted for this job by their proved ability to record accurately as many as 16 temperatures per instrument, either near or remote. Fully automatic operation plus sturdiness of all parts of the equipment reduce instrument care to a minimum.

If you have the problem of reading scattered temperatures, you'll find valuable information in Catalog N-33A (Micromax Thermocouple Pyrometers) or Catalog N-33C (Thermohms), sent on request. Or, if you'll outline your specific needs, we'll send the detailed recommendation of an L&N engineer.

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

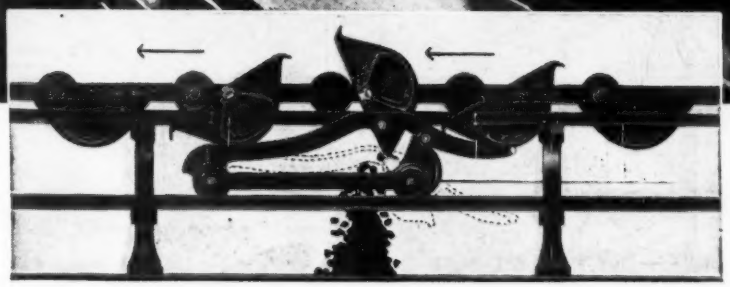
LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-33-220(1)

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," "The Stationary Engineer"), July, 1946, Vol. 90, No. 7. Published monthly with an additional Directory in December. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 N. Broadway, Albany 1, N. Y. Editorial and executive offices, 330 W. 42nd St., New York 18, N. Y. Entered as second class matter August 25, 1936, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, Power, 330 W. 42nd St., New York 18, N. Y. Subscription rates—U. S. and U. S. Possessions, $3 for one year, $4 for two years. 50c per single copy Canada, $5 for one year, $8 for two years. Pan American countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years.

TECHNOLOGY DEPT.



WITH INSIDE BUNKER STORAGE

Peck Overlapping Pivoted Bucket Carrier Handles Coal at Lowest Cost

VERSATILE: Handles coal, Fuller's earth; materials at high temperature; abrasive materials such as ashes, coke, ore and cement clinker.

SAVES POWER; SAVES SPACE

Low travel speed, simple drive and large roller suspension save power. Used within boiler room walls (without cutting walls or roof, or erecting penthouses). Carries the load instead of dragging it.

LOW UPKEEP; HIGH CAPACITY

Malleable buckets and chain (instead of steel) resist corrosion and permit increased bearing area without excessive chain weight. Equalizing gears insure smooth operation. Coal capacities from 15 to 250 tons per hour; greater for other materials.

MODERNIZED DESIGN

Up-to-date improvements and standardization of individual units and assemblies reduce installation and operation cost, and permit flexibility of conveyor layout.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8.
Offices in Principal Cities. 10,204

This time-proved carrier-unit elevates and conveys in a continuous flow, without transfer points . . . vertically, horizontally, on an incline, over any path of travel in a single vertical plane. There may be one or several loading points; and the discharge, which is positive and complete, may be concentrated or distributed.

The buckets are always maintained in a horizontal position except when discharging . . . no auxiliary devices or complicated mechanisms necessary. Materials can be carried at high temperature.

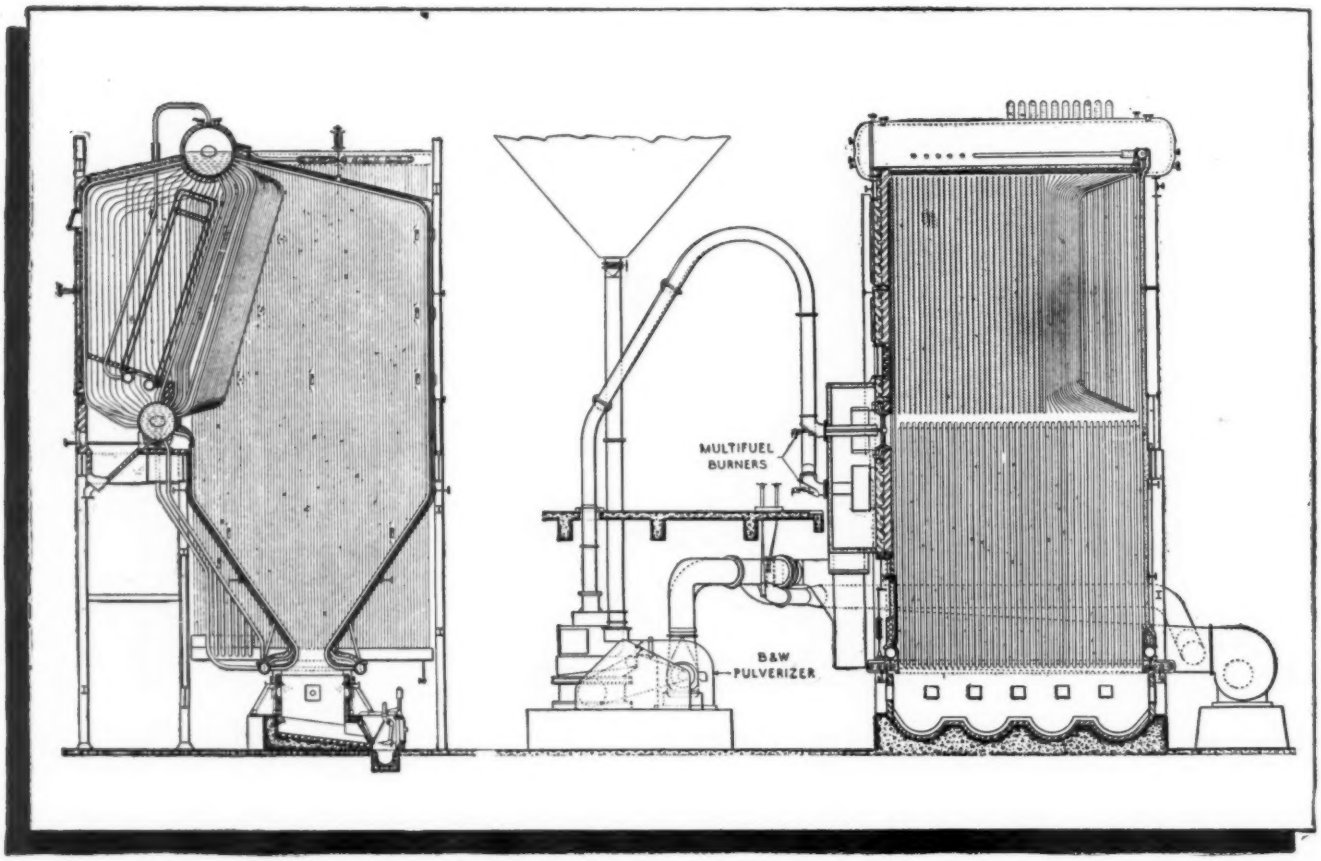
More than 50 miles of Peck Carrier are in use cutting material handling costs. Because of its mechanical features, there is no other method more efficient and economical in its field. For details write for Book No. 1720.*

LINK-BELT

THE SYMBOL OF QUALITY — LB — LINK-BELT

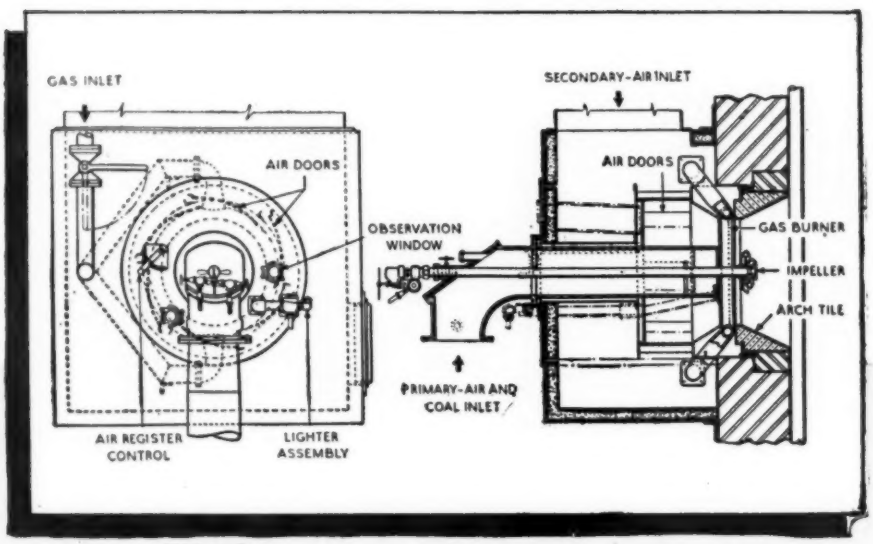
COAL AND ASHES HANDLING EQUIPMENT

Use All Three



Above—Typical B&W Integral-Furnace Boiler arranged for Multi-Fuel Firing.

Right—Details of B&W Multi-Fuel Burner.



with ONE Burner

No need for converting and then re-converting . . . or equipping boilers with *separate* burners for using coal, oil, and gaseous fuels together when any one fuel becomes scarce. Changing conditions in fuel needs and availability can always be met when your boilers are equipped with the

B&W MULTI-FUEL CIRCULAR BURNER for Pulverized Coal, Oil, and Gas

This burner provides in ONE compact unit the features of the B&W Combination Oil and Gas Burner and those of the B&W Circular Burner that is so widely used for pulverized fuels. This combination, properly co-ordinated with furnace and boiler design, provides a wide latitude in choice of fuels:—all grades of coal and petroleum coke in pulverized form, oil, and gas. These may be burned singly or in any desired combination. High combustion efficiency with *any* fuel is assured through turbulent mixing of fuel and air. Let Babcock & Wilcox engineers explain how this equipment can simplify your fuel-burning problems.

Send for Bulletin G-20 A describing this B&W Multi-Fuel Burner and the B&W Combination Oil & Gas Burner.

B&W

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
85 LIBERTY STREET • NEW YORK 6, N. Y.

G 2197

A mid-war

THIS ELLIOTT TURBINE-GENERATOR

together with other improvements has permitted a saving of at least 7000 tons of coal per year at the plant of Libbey-Owens-Ford Glass Company, Rossford, Ohio. The modernization project was planned and carried out by Stone & Webster Engineering Corporation, under the direction of Mr. D. H. Goodwillie, Executive Vice-President, Mr. C. L. Drake, Director of Engineering, and Mr. W. H. Hasselbach, Chief Engineer of Libbey-Owens-Ford Glass Company.

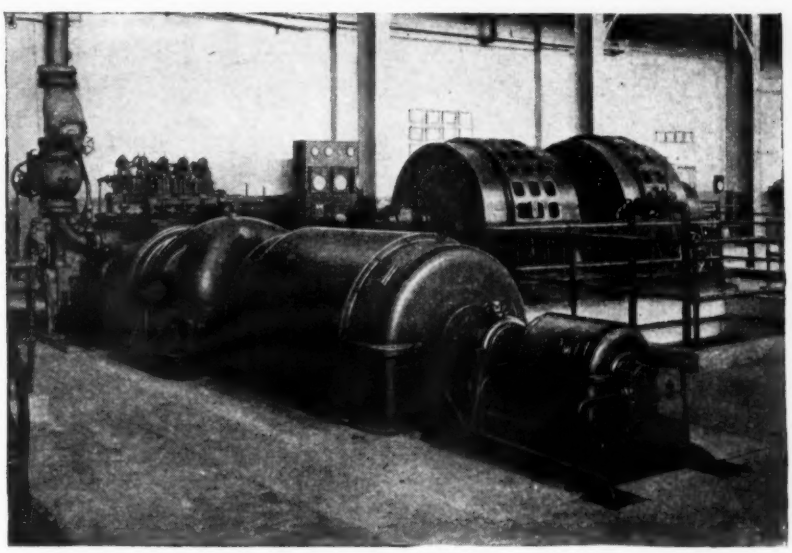
ELLIOTT

modernization · · *justified by its big potential savings*

Seven thousand tons yearly is a lot of coal. As a wartime saving it bulked far larger than the necessary critical materials and labor required to provide the new Elliott turbine-generator which, it was expected, would effect the economy. So, late in 1944, even while hostilities were "hitting on all eight", the War Production Board gave the go-ahead signal for the building and installation of this 2500-kw Elliott automatic extraction turbine-generator unit, in the Rossford, Ohio, plant of Libbey-Owens-Ford Glass Company. Engineering design and construction were conducted by Stone & Webster Engineering Corporation, Boston.

One side-light on this modernization job is of interest. The installation had been contemplated originally on the basis of a 2000-kw Elliott unit, the order given in 1941 and fabrication already begun, when war strictures intervened. By the time the order was released, power requirements had jumped to 2500-kw and process steam demand had increased. Because of the generous design of the partially completed Elliott unit, it was possible with some alterations, to increase its capacity as required by the new conditions.

The unit is now installed, and operating fully as expected. Demonstrating that the economy characteristics of Elliott turbine-generators are based upon sound engineering.



The new Elliott 2500-kw automatic extraction turbine-generator seen from the generator end. The turbine operates on 400-psi, 750 F steam, with extraction at 185 psi, 620 F to process.

H-69

Elliott Company

***Steam Turbine Department*, JEANNETTE, PA.**

Plants at: JEANNETTE, PA. • RIDGWAY, PA. • SPRINGFIELD, O. • NEWARK, N. J.

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STEAM TURBINES • GAS TURBINES • GENERATORS • MOTORS • CONDENSERS • FEEDWATER HEATER AND DEAERATORS • STEAM JET EJECTORS • CENTRIFUGAL BLOWERS • TURBOCHARGER FOR DIESEL ENGINES • TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTER

1765 Boilers
are now equipped with
DIAMOND
"AIR PUFF"
Soot Blowers

In the 15 years since Diamond Automatic Sequential "Air Puff" Soot Blowers were first installed, 1765 boilers have been equipped with them. Year after year the successful operation of the rapidly increasing number of these blowers is convincing testimony to the soundness of the Diamond "Air Puff" blowing principle.

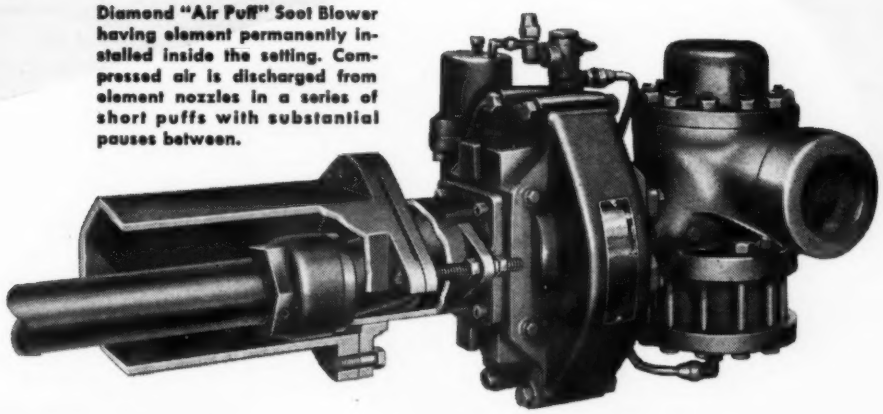
Practically every type, size and pressure are included in the 1765 boilers—heating—marine—power—up to public utility giants of 900,000 pounds per hour capacity. "Air Puff" Soot Blowers are used alone and in combination with the other types of Diamond Soot Blowers.

Compressed air has a greater density than steam and therefore provides better cleaning. The air is discharged in a series of short puffs with substantial pauses between. Spreading the cleaning cycle over a longer period of time permits use of a much smaller compressor and receiver. The many other advantages of Diamond "Air Puff" Soot Blowers are briefly mentioned on the right-hand page. Write for further information.

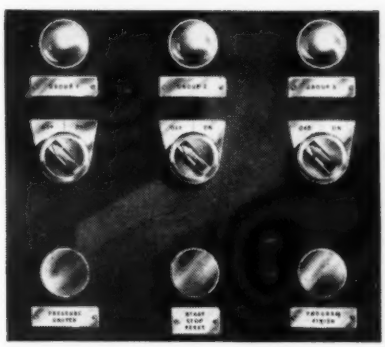
DIAMOND POWER SPECIALTY

DIAMOND SPECIALTY LIMITED,

Diamond "Air Puff" Soot Blower having element permanently installed inside the setting. Compressed air is discharged from element nozzles in a series of short puffs with substantial pauses between.



Master Controller which automatically controls the sequence and blowing time of Diamond "Air Puff" Soot Blowers only. Just a twist of the wrist to open a valve . . . the controller does the rest.



Program panel for controlling Diamond "Air Puff" Soot Blowers in combination with other blowers. All are operated in correct sequence and at right blowing speed by simply pushing one "start" button.

AUTOMATIC SEQUENTIAL OPERATION

ASSURES CORRECT CLEANING

"Human element" is entirely eliminated and each blower unit must operate in correct sequence and at right speed every time. No unit can be overlooked by careless operator.

SAVES LABOR

No attendant needed to drain piping, warm it up, and then operate each individual blower unit.

SAVES FUEL

Uses only ⅓ to ⅔ of energy from coal pile needed for steam blowing.

OTHER "AIR PUFF" ADVANTAGES

NO FEED WATER MAKEUP

Using compressed air instead of steam as cleaning medium, there is no condensate loss due to soot blowing.

STACK DISCHARGE NUISANCE MINIMIZED

Intermittent operation expels soot from boiler in small quantities.

REDUCED MAINTENANCE

Many years' experience proves maintenance costs are unusually low.

PIPING INSULATION ELIMINATED

When air is used for cleaning, soot blower piping is not insulated.

CORPORATION DETROIT 31, MICHIGAN

WINDSOR, ONTARIO

TIPS on how to select Boiler Control

1 Profit from the Experience of Others

It is likely that plants of the type you are considering are being already operated at optimum performance by Bailey Boiler Control. When you select Bailey Controls, you profit from this experience and get the benefit of the latest refinements in application. Over 8,000 boiler units have been equipped with Bailey Controls during the past 10 years. These units range from from 3,000 to 1,000,000 lb. per hour capacity and operate at pressures from 75 to 2500 psi. They are fired by pulverized coal, stokers, oil, gas, mixed fuels and waste fuels.

2 Call in Qualified Engineers

Bailey Engineers are qualified by training and experience to consult with you on both the theoretical and practical aspects of your boiler control problems. These specialists in combustion, measurement, and automatic controls are conveniently located in over 30 industrial areas throughout the United States and Canada. Your local Bailey Engineer stands ready and willing to apply the Company's know-how to your plant.

3 Specify a Dependable System

Records indicate that compressed air is a reliable operating medium. Unlike electricity or oil, it continues effective for a time after power failure.

BAILEY METER COMPANY

1036 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Bailey Boiler Controls are sturdy air-operated units which function in accordance with accurate measurements made by Bailey Meters.

4 Avoid Make-shift Applications

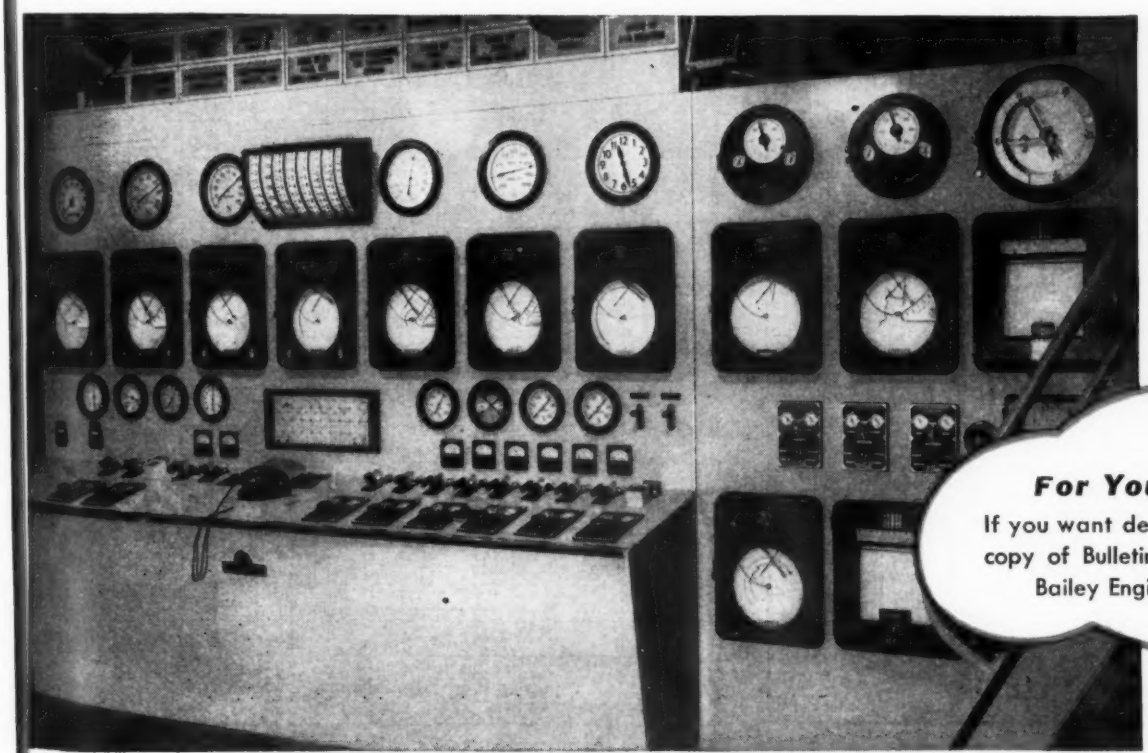
The wide selection of both measuring and controlling elements offered by Bailey Meter Company provides complete flexibility of control application. The correct combination of these elements does a thorough job without excessive equipment.

5 Insure Smooth Operation

Coordination of related control systems such as combustion, feed water, steam temperature, and condensate flow insures against costly disturbances in plant operation. Proper coordination improves control action, increases safety of operation, reduces auxiliary power required and reduces storage capacity needed in heaters and boiler drums.

6 Be Sure You Can Get Service

Users of Bailey Control have but to call on the nearest branch office of Bailey Meter Company to secure the services of a trained engineer.



For Your Plant

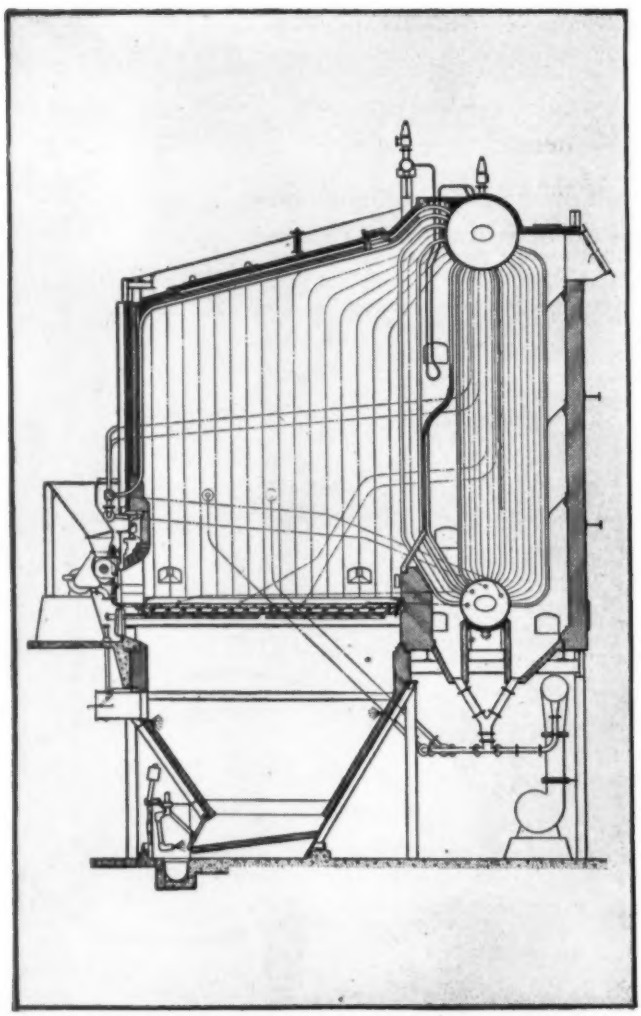
If you want details write for a copy of Bulletin 15-D, or ask a Bailey Engineer to call.

Bailey Control Board for Riley Boiler at Harbor Steam Plant, City of Los Angeles, California. This board carries measuring equipment for the control of combustion, feed water, superheated steam temperature, fuel oil temperature, and air heater temperature. It also includes a Bailey Oxygen Recorder and a Bailey Smoke Density Recorder. The controls provide for quick pick-up of load from 60,000 lb. per hour to 690,000 lb. per hour in the event of an interruption in hydro power.

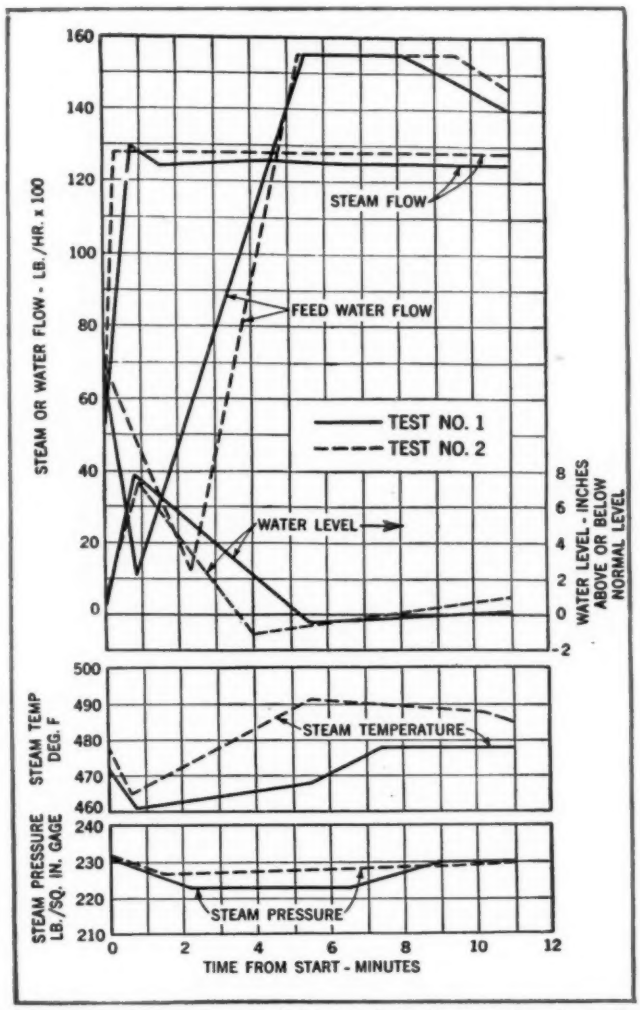
A-97

from 53,000

lb of steam per hr



This is the design responsible for the results shown on the adjacent chart. It comprises a C-E Steam Generator, Type VU, fired by a C-E Spreader Stoker. Guaranteed Capacity — 100,000 lb of steam per hr (Maximum Continuous).



The above chart was plotted directly from figures taken from the recording instruments and readings made during the tests. The results of the tests are briefly discussed on the opposite page.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

to 130,000..

...in 40 seconds flat!

During the war Combustion Engineering was asked to design a steam generating unit capable of taking extreme load swings in a matter of seconds . . . without serious effect on steam pressure or temperature. A number of such units were installed in a "top secret" plant; they combined the VU Steam Generator with the C-E Spreader Stoker.

Then came the tests . . . tests of the utmost severity to determine just how well these units could handle the job for which they were designed. The results are here charted and briefly described. Not only did the unit more than meet specified performance but the results were all within our predicted limits of variation in operating conditions.

Summary of Test Results

The first test was a brief preliminary that shot the rating from 60,000 to 108,000 lb of steam per hr.

Then followed the first formal test, results of which are plotted as solid lines on the accompanying chart. Load was zoomed up from 53,000 to 130,000 lb per hr in 40 seconds. Maximum temperature drop was 13 deg. F; maximum pressure drop was 9 psi.

They tried it again. Up went the steam demand from 60,000 to 128,000 lb in 20 seconds. (See dash lines on chart.) Same story — pressure drop 5 psi, temperature drop 11 deg. F.

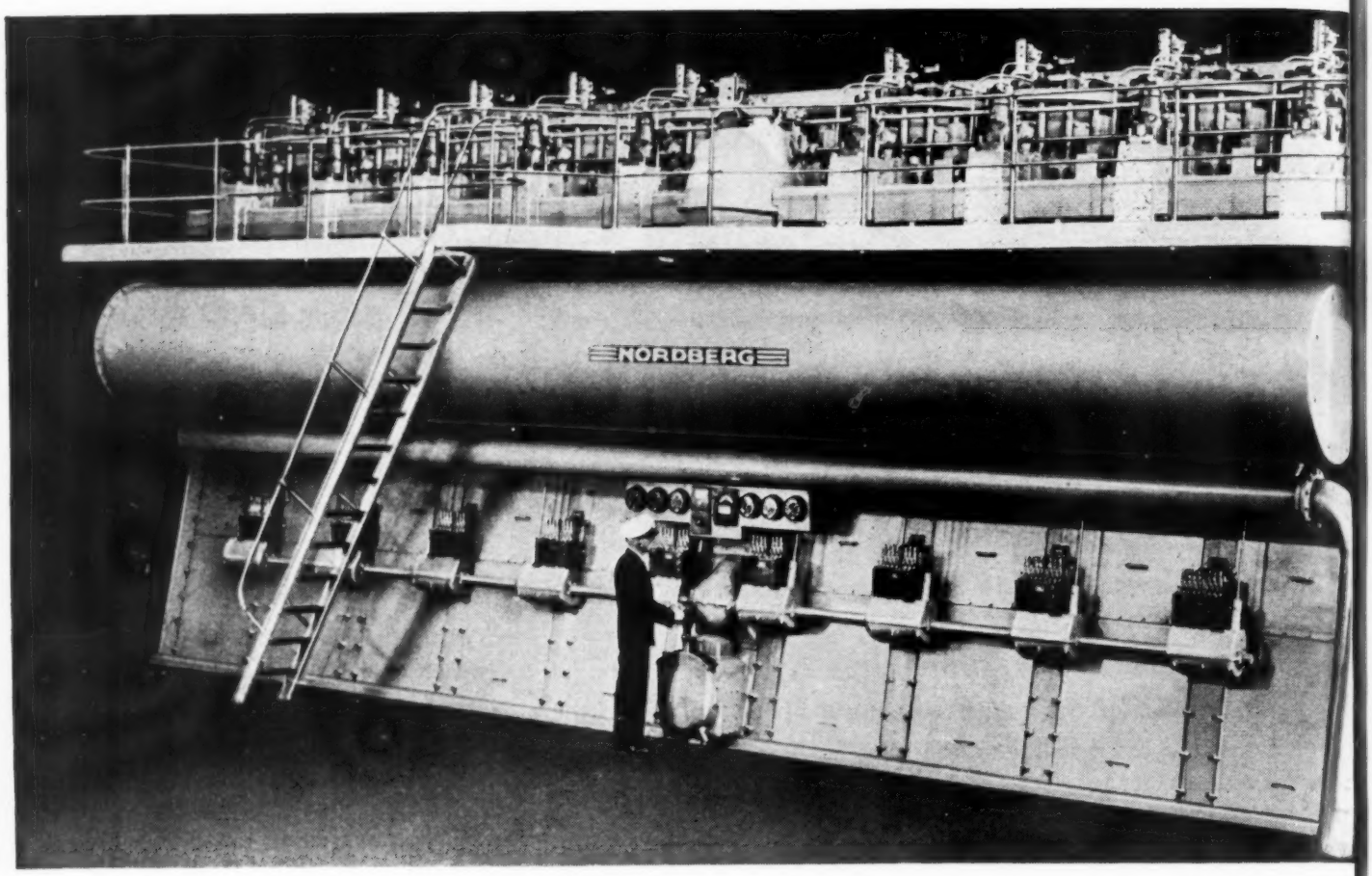
The maximum change in water level under these conditions was a 7.3 inch rise; maximum increase in solids carryover was 1.1 ppm.

On the score of flexibility and load pick up nothing need be added to the foregoing performance figures, but the following paragraph from one of the test reports is significant because it indicates the reserve capacity inherent in C-E Spreader Stoker design — "After the output of 128,000 lb per hr was reached in the second test increase, one distributor unit was taken out of service and the load maintained with the four remaining units. When it became obvious that the load could be maintained with only four units in service and with some stoker capacity still in reserve, the five sections of the fire were cleaned consecutively without the use of any firing tools."

A-971

ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.



Largest to

PEAK PERFORMANCE

REGARDLESS of size or type, you'll get peak performance from your Diesels by lubricating with *Texaco Ursa Oils.* These famous oils have been kept in step with Diesel engine developments over the past 30 years. They keep engines clean . . . assuring active valves, free rings, proper seal . . . efficient, full-power operation.

Texaco Ursa Oils greatly reduce wear, and prolong the life of bearings, liners, rings and pistons. Their use assures lower maintenance and fuel costs. There is a complete line of *Ursa Oils* to meet every Diesel requirement.

All leading Diesel engine manufacturers approve *Texaco Ursa Oils,* and they are used by operators the world over. In the United States—

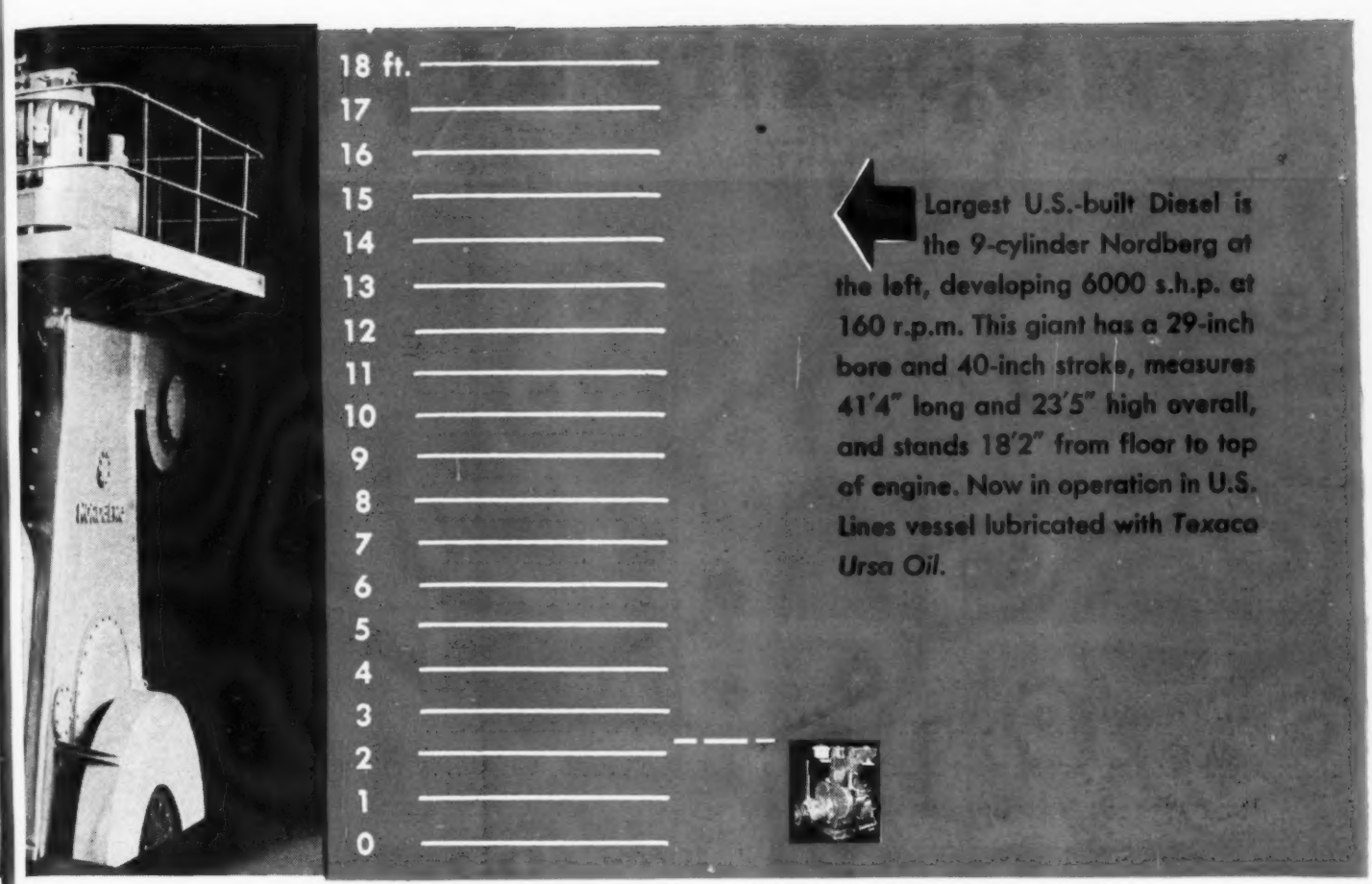
More stationary Diesel hp. is lubricated with Texaco than with any other brand!

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT —CBS

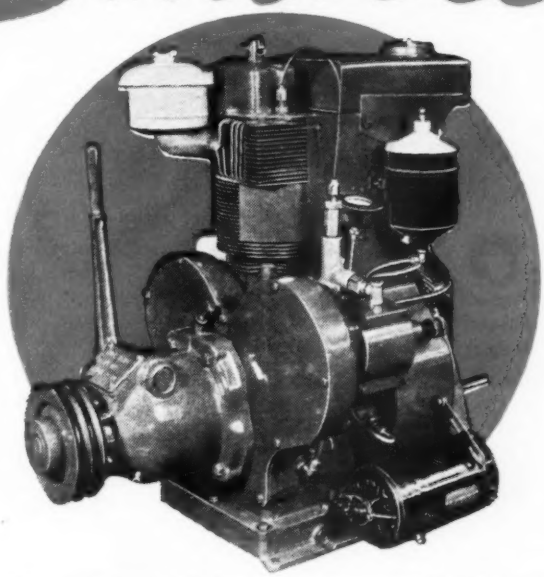
TEXACO

TEXACO



Largest U.S.-built Diesel is the 9-cylinder Nordberg at the left, developing 6000 s.h.p. at 160 r.p.m. This giant has a 29-inch bore and 40-inch stroke, measures 41'4" long and 23'5" high overall, and stands 18'2" from floor to top of engine. Now in operation in U.S. Lines vessel lubricated with *Texaco Ursa Oil.*

Smallest

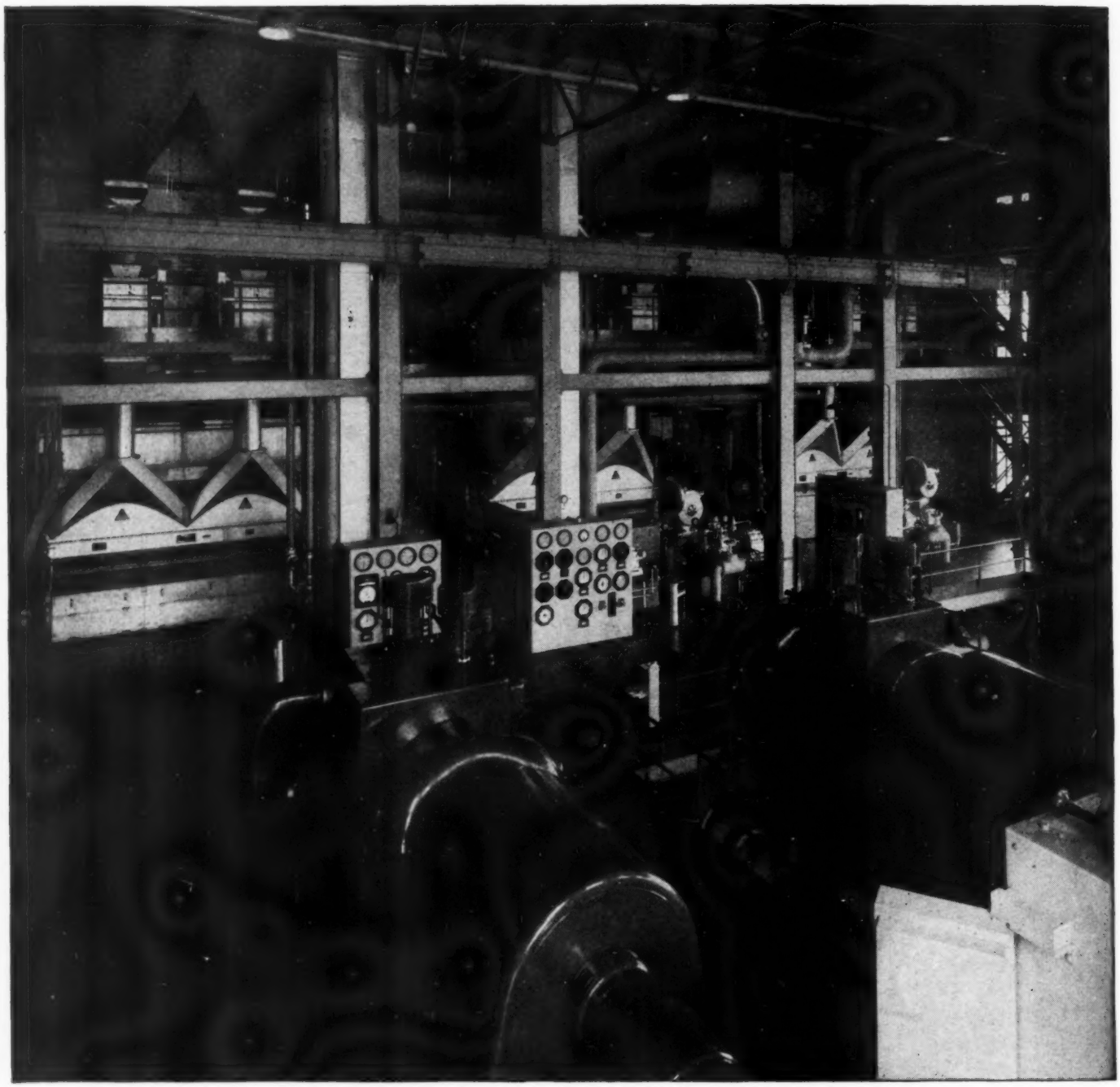


Smallest U.S.-built Diesel is the new, one-cylinder, *air-cooled* Sheppard, shown above in scale with the Nordberg. It develops 3¾ hp. at 1800 r.p.m. and has a 3-inch bore and 4-inch stroke. Overall dimensions: 28½" high and 22½" long. *R. H. Sheppard Company approves lubrication with Texaco Ursa Oil.*

URSA OILS

FOR ALL DIESEL ENGINES

Specify Republic



A Republic combustion control system operates the three boilers in this new power plant which supplies all the steam and power for a large university. During the first year of operation this new plant provided heat for 13.0 percent more building space, generated 114.3 percent more electric power but consumed 9.86 percent less fuel.

REPUBLIC
INSTRUMENTS
AND CONTROLS

Combustion Control

TO INCREASE TODAY'S STEAM PRODUCTION

TO DECREASE TOMORROW'S STEAM COST

The installation of Republic automatic controls on your boiler (or boilers) will enable you to:—

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hr. a day, 7 days a week.

CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently developes as a result of incorrect boiler operation.

An automatic combustion control system, as designed and built by Republic, will help you meet today's need for more steam and tomorrow's need for lower steam costs.

The Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency. It not only checks operation but automatically makes necessary corrections of individual factors before faulty operation has a chance to develop.

The difference between such a control and an assembly of uncoordinated regulating devices is comparatively small in equipment but great in principle. Merely to provide automatic operation of a number of individual device is not enough.

CHECK THESE FEATURES

Built into the Republic combustion control systems are many features that enable it to fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of everyday operation.

Check the following features against your list of "musts" for a perfect combustion control system.

CENTRALIZED CONTROL: The operation and control of the boiler or boilers is centralized at the master controller.

FUEL-AIR RATIO INDICATOR: The master controller is provided with mercury manometers which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

FUEL-AIR RATIO ADJUSTMENT: A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

ALL BOILER RATINGS: Maintains proper fuel-air ratio over the entire range of boiler ratings.

CONSTANT STEAM PRESSURE: Maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

LOAD DISTRIBUTION: Provides a means of distributing the load among the boilers as desired.

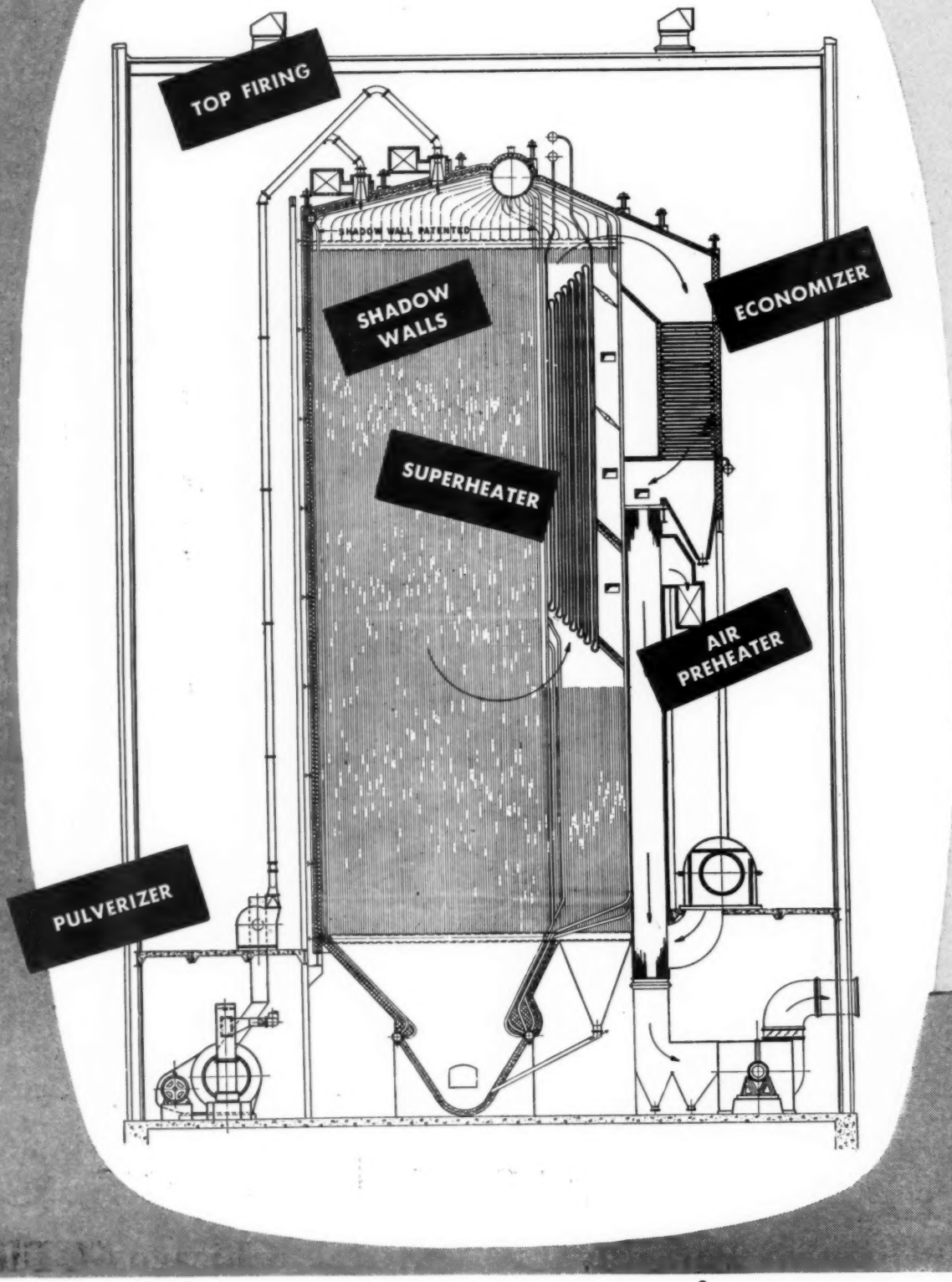
MANUAL CONTROL: Boiler ratings can be controlled manually by a handwheel located on the front of the panel.

Find out about Republic control systems. One of our engineers will be glad to consult with you at any time. Write us today.

Republic Flow Meters Co.

2240 Diversey Parkway • Chicago 47, Illinois

KVS STEAM GENERATING



EQUIPMENT...

provides ***latitude in proportioning to assure efficient operation on any type of fuel . . . coal, gas or oil***

SHADOW WALLS

KVS furnace shadow walls present one of the most efficient radiant heat designs in modern steam generators. This furnace design eliminates convection boiler surfaces, permits the use of a single drum for steam collection and assures even control for all loads within the limits of the design.

SUPERHEATER

A pendant type superheater with thermostatically controlled by-pass damper arrangement affords control of superheat temperature over the entire boiler range.

TOP FIRING

This feature of KVS design permits the burning of either bituminous or anthracite coal with equally assured success.

PULVERIZER

Perfect pulverization with the KVS Integral Drive Tube Mill is controlled by air separation. Low power and maintenance costs can be depended on regardless of the grade of coal handled. Proper preparation of all grades is assured.

ECONOMIZER

The convection sections of the economizer are located directly back of the convection superheater. Gas enters at the top and provides a counterflow to the water circulation thereby assuring a high ratio of heat transfer and increasing the overall efficiency of the steam generator.

AIR PREHEATER

This component is of tubular design. Downflow of gases within the tubes and upward cross circulation of the air surrounding the tubes result in high temperature air necessary for perfect combustion.

ENGINEERING SERVICE

KVS offers a complete service for the design, building, erecting and furnishing complete, ready-to-operate steam generating plants including all essential components. This service is available under one responsibility.

This unit typifies the sound technical "know-how" applied in KVS engineering by providing adequate furnace volume, combustion equipment and all related components. High efficiencies with any grade of coal that will be available for many years to come are thereby assured. Send for Catalog No. 44B.

KENNEDY-VAN SAUN · QUALITY · SERVICE · Kennedy Products · NEW YORK USA · MFG. & ENG. CORP.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

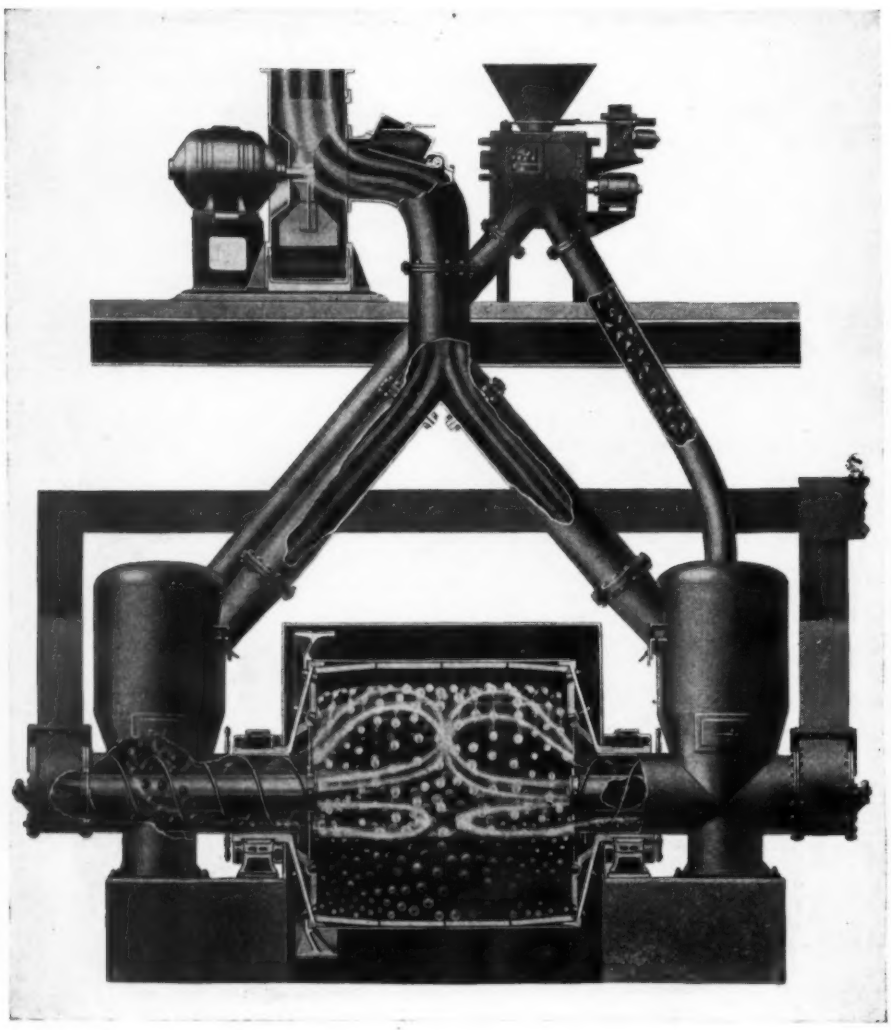
PULVERIZER MAINTENANCE COSTS

. . . AGE OF MILLS

Figures reflecting the cost of maintaining 9 Foster Wheeler ball mill pulverizers over a 13-year period reveal two interesting and important facts:

As the yearly tonnage of fuel pulverized increased, mill maintenance costs remained virtually unaffected, except...

As labor and materials costs decreased, mill maintenance costs decreased; as labor and materials costs increased, mill maintenance costs increased. ***Mill age does not appear as a factor in pulverizer maintenance costs.***

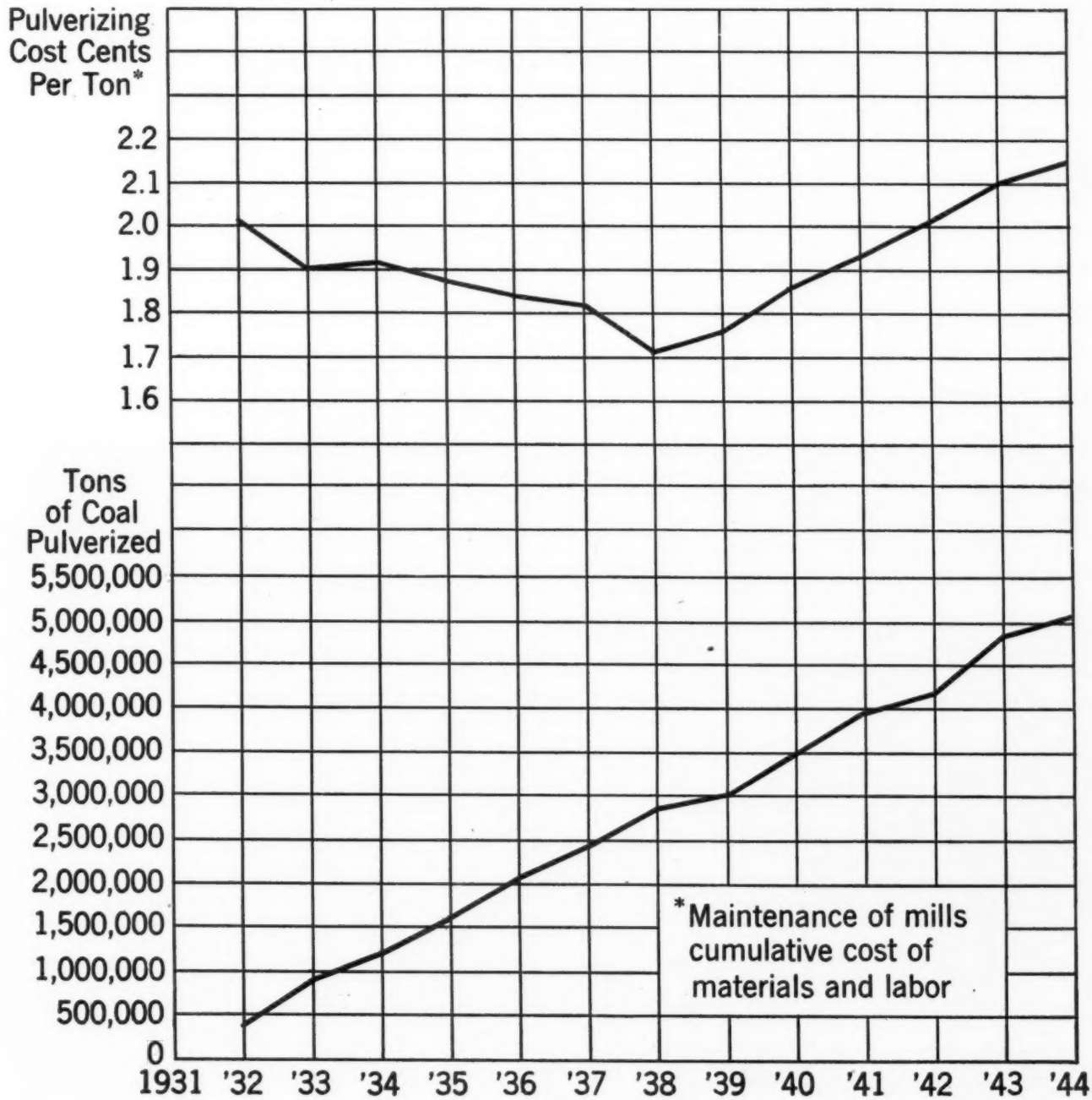


Low maintenance costs enjoyed by operators of Foster Wheeler ball mill pulverizers are only one side of dual advantages. Corollary to low maintenance is high availability—continuous service records show consistent operation with 99 percent availability. Routine inspections account for the one percent shut down—and these can be made to coincide with boiler inspections.

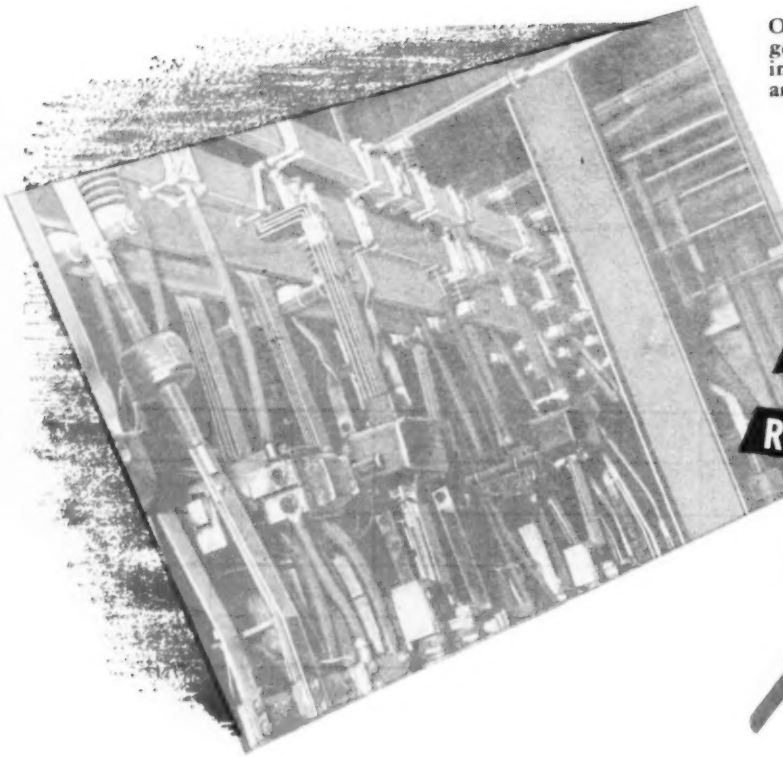
FOSTER WHEELER CORPORATION
165 Broadway • New York 6, N. Y.

REFLECT LABOR & MATERIALS COSTS

NOT A FACTOR



FOSTER WHEELER



Obsolete, open-type switchboard construction, congested by additions made from time to time, resulted in a condition dangerous to operating continuity and to personnel.

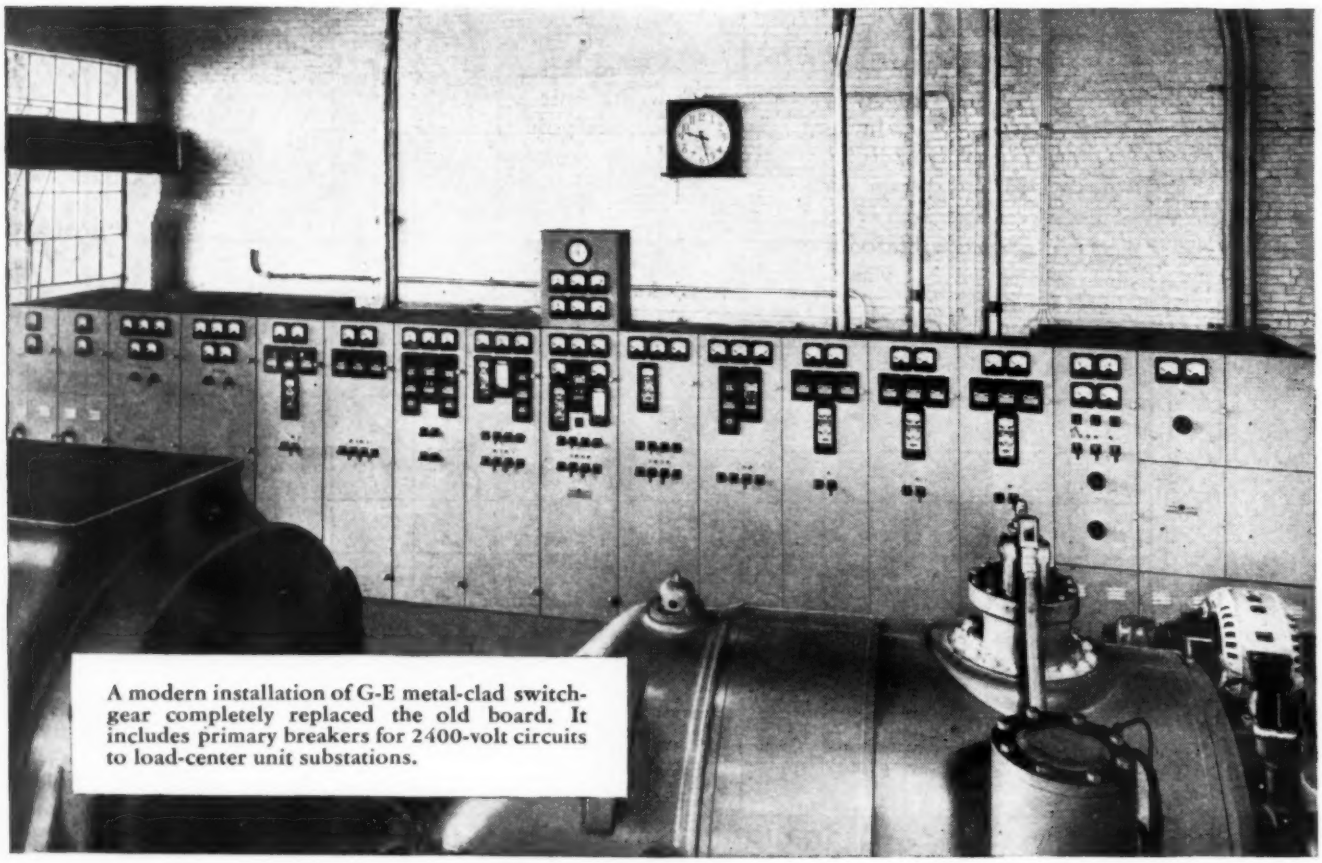
FREQUENT OUTAGES

DANGER TO PERSONNEL

POOR VOLTAGE CONDITIONS

RESTRICTIONS ON GROWTH

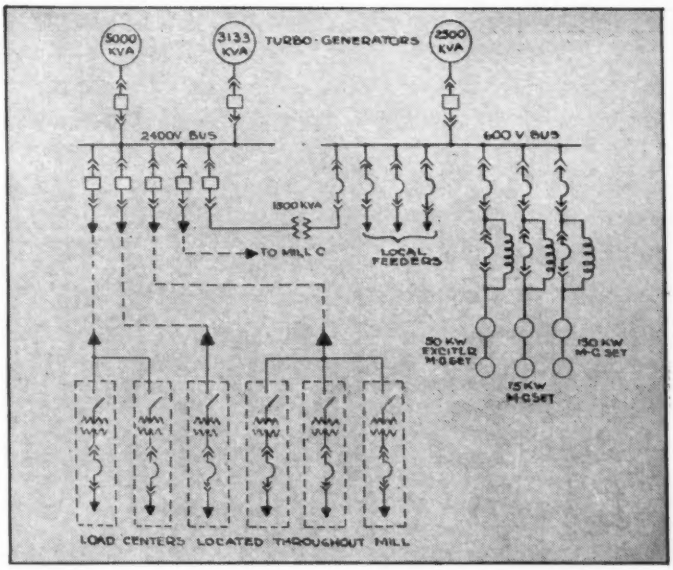
Removed



A modern installation of G-E metal-clad switchgear completely replaced the old board. It includes primary breakers for 2400-volt circuits to load-center unit substations.

GENERAL ELECTRIC

321-45-5900



Switchgear and Load-center Unit Substations are Shown in this One-line Diagram.

Originally, the 5000-kva generator was wound for 600 volts, and all but one circuit (to mill C) was powered from the 600-volt bus. The change to 2400-volt distribution brings short-circuit amperes to a value consistent with moderate-sized circuit breakers.

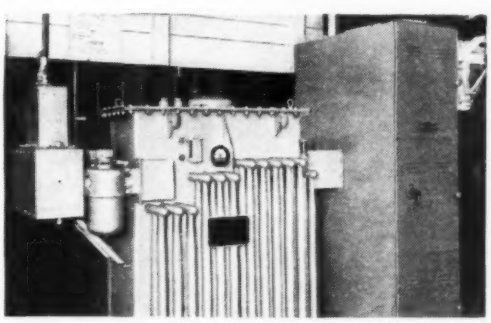
...BY G-E LOAD-CENTER UNIT SUBSTATIONS

● An old, inadequate plant power system was an open invitation to trouble at this mill. Electrical outages were delaying production. Circuits and switchgear which had been added piecemeal added to the danger of inadequate interrupting capacity. In spite of large secondary feeders, the distribution of 10,000 kva at 600 volts had created unsatisfactory voltage conditions.

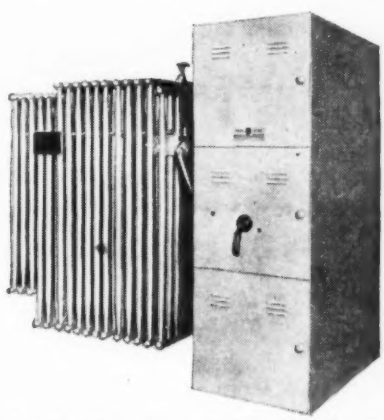
Analysis showed that further patchwork would be a costly practice. A new power distribution system, based on the use of G-E unit substations, was planned with the help of G-E engineers.

Now primary distribution is made at 2400 volts over cable that keeps voltage drop down, though it's modest in size. The powerhouse switchgear is all G-E metal-clad, equipped with magne-blast oil-less air circuit breakers. At load-center locations throughout the plant, six unit substations are installed, to step down from 2400 volts to 600. Individual circuits are fully protected by convenient metal-enclosed drawout air circuit breakers that are an integral part of the unit substation.

This new protection against outages and obsolescence is already justifying itself in power continuity and lowered costs. Why not determine, without obligation, if power-system replacement could do as much for you? Just call your local G-E representative. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



Typical load-center unit substation, as installed at locations which permit short low-voltage feeders to points of power use.



Another load-center unit installed in the mill, stepping 500-kva down from 2400 volts to 600. Draw-out air circuit breakers are co-ordinated with substation size to give full short-circuit protection without excess breaker size. Substation transformers use Pyranol non-inflammable insulating liquid.

LOAD-CENTER POWER DISTRIBUTION UNITS

BRONZE "RENEWO" VALVES

REGULAR TYPE
Fig. 73....200 lb. S.P.
Fig. 16....300 lb. S.P.

PLUG TYPE
Fig. 73-P..200 lb. S.P.
Fig. 16-P..300 lb. S.P.

Here's all you need....

to convert a regular type into a plug type valve

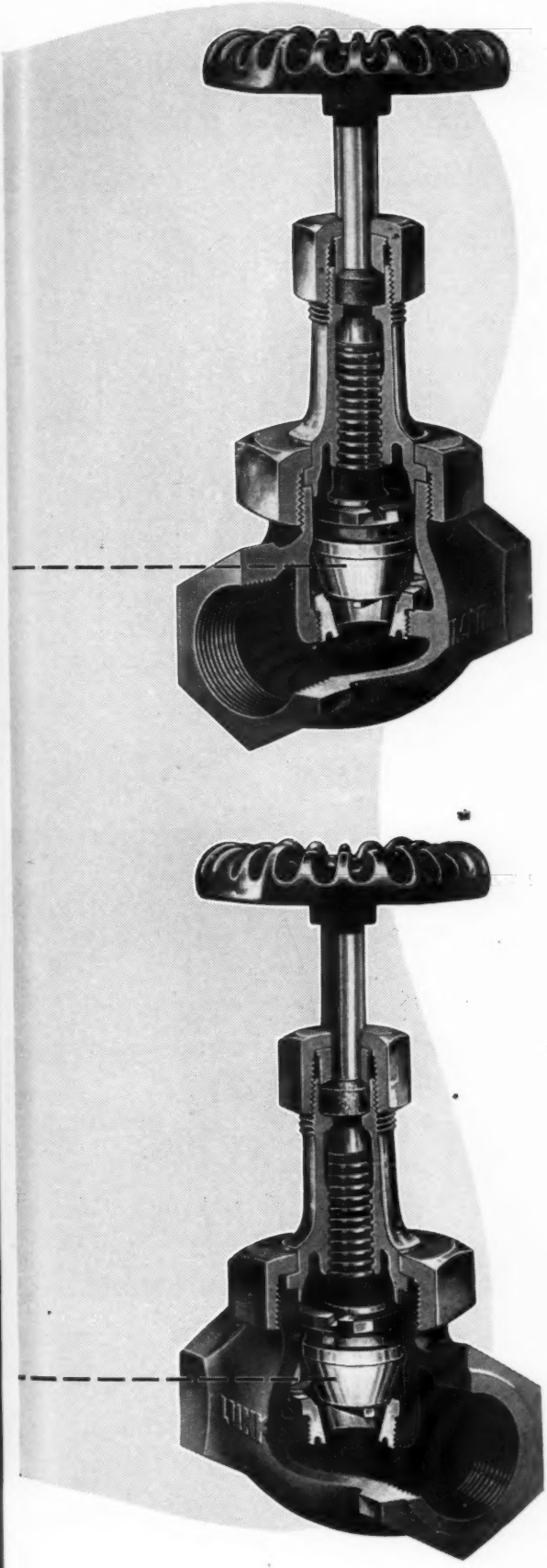
SEATS AND DISCS INTERCHANGEABLE*

IRON BODY "FERRENEWO" VALVES

REGULAR TYPE
Fig. 1021...150 lb. S.P.

PLUG TYPE
Fig. 1021-P.150 lb. S.P.

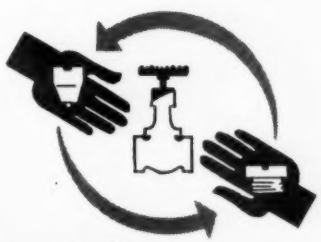
LUNKENHEIMER VALVES ... *FASTER, EASIER,*



Just insert a plug type seat and disc in place of the regular type, and you change an *entire* Bronze "Renewo" Valve from regular to plug type—providing all the extra advantages of this type, including its ability to stand up under unusually hard service. *No* other change is necessary. The plug type seat-and-disc combination is made to *fit perfectly* into a regular type valve of corresponding size and pattern. And you have this same interchangeability in Iron Body "Ferrenewo" Valves. You don't have to buy an entire new valve . . . you don't even have to take the valve out of the line.

*Lunkenheimer interchangeability goes still farther. *All parts* of 200 lb. "Renewo" and 150 lb. "Ferrenewo" Valves (except bodies and bonnet rings) are quickly, easily, perfectly interchangeable. Fewer parts are needed; ordering and handling are simplified; repairs are facilitated. You save time, labor, money. Write for a copy of Circular 567—

LET YOUR LUNKENHEIMER DISTRIBUTOR DEMONSTRATE . . .



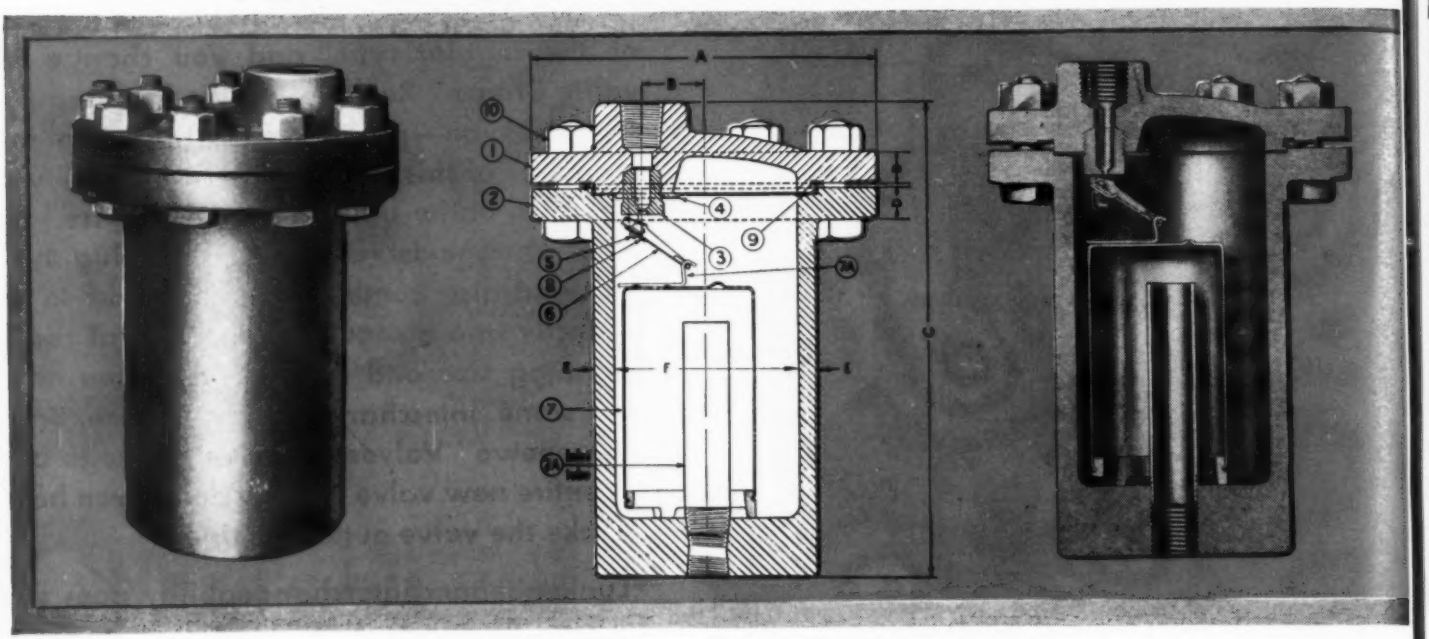
Your nearby Lunkenheimer Distributor will welcome the opportunity to show you actual samples and demonstrate the interchangeability of parts in "RENEWO" and "FERRENEWO" Valves. You'll find it a big factor in increasing efficiency, lowering costs.

THE LUNKENHEIMER COMPANY

CINCINNATI 14, OHIO, U. S. A.
NEW YORK 13, CHICAGO 6, BOSTON 10, PHILADELPHIA 7.
EXPORT DEPARTMENT: 319-322 HUDSON ST., NEW YORK 13, N. Y.

LOWER--COST MAINTENANCE!

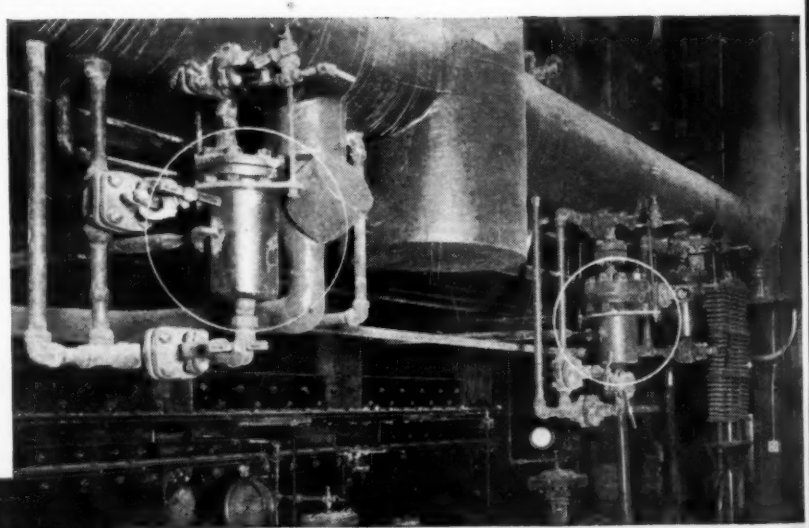
FORGED STEEL

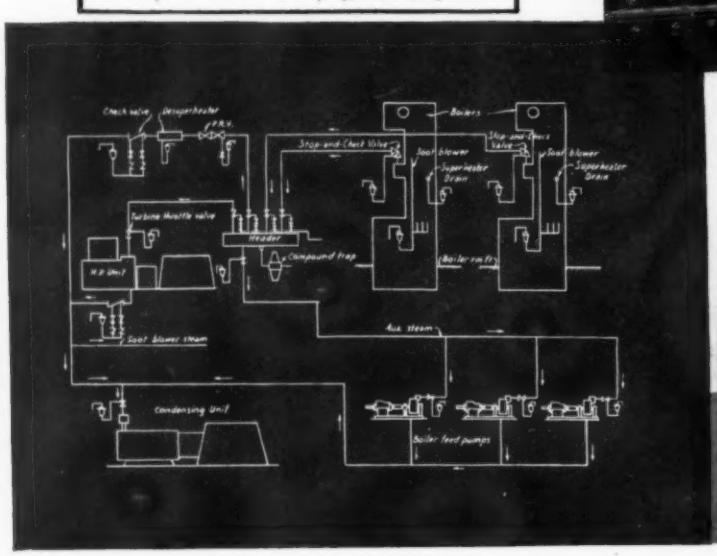


. . . with screwed connections

LIST OF MATERIAL
(Traps No. 312-515)

Part No.	Name of Part	Material
1 & 2	Cap and Body	Die Forgings (S.A.E. 1030) 79,000 lbs. Tensile Strength
2A	Inlet Tube	Wrought Iron
3	Valve Seat	Chrome Steel (Heat Treated)
4	Guide Pin Assembly	18-8 Stainless Steel
5	Valve	Chrome Steel (Heat Treated)
6	Lever	18-8 Stainless Steel
7	Bucket	18-8 Stainless Steel Cap & Tube—Cast Iron Bottom Weight
7A	Bucket Hook	18-8 Stainless Steel
8	Valve Retainer	18-8 Stainless Steel
9	Gasket	Compressed Graphited Asbestos
10	Bolt & Nut Set	Bolts Supertemp Steel, 149,000 lbs. Tensile, nuts hex. semi-finish (S.A.E. 1030)





Above — Armstrong No. 315 and 515 Forged Steel Traps in a central station.

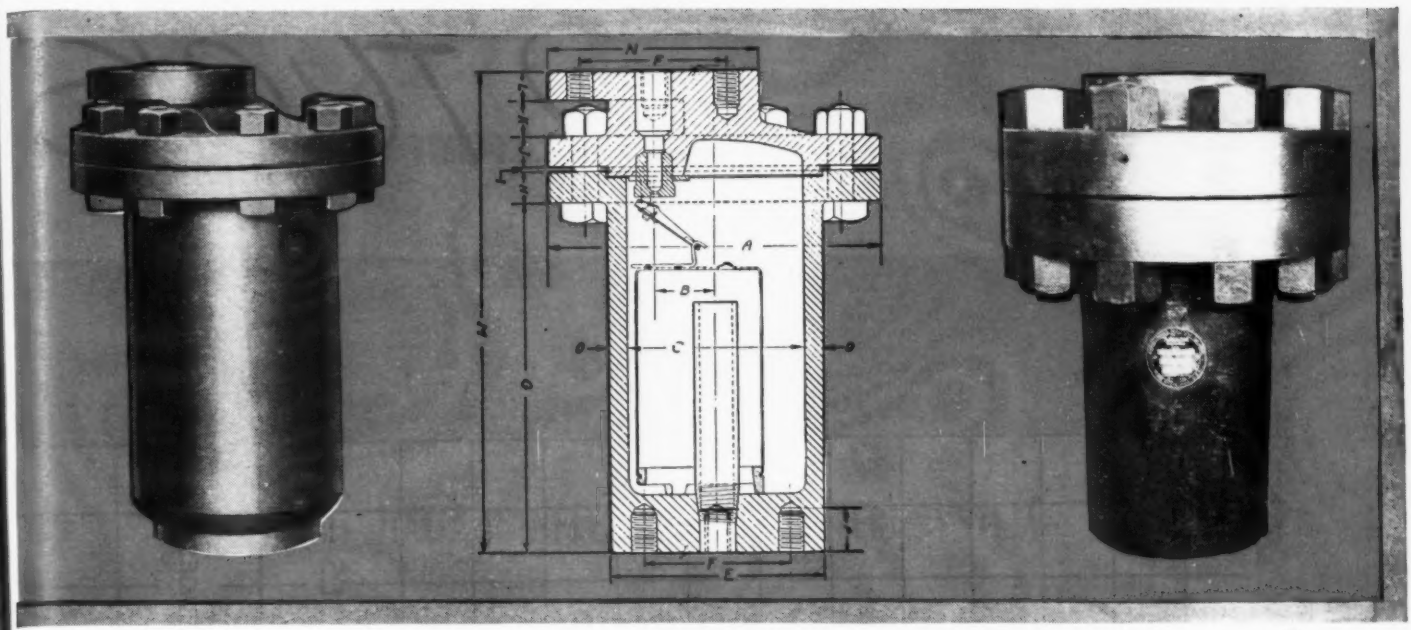
Left — Typical Armstrong trap applications in a modern power plant.

Right — Armstrong Forged Steel Traps at a Midwest utility plant.

ARMSTRONG STEAM TRAPS

ARMSTRONG

TRAPS ... for pressures up to 2400 lbs.



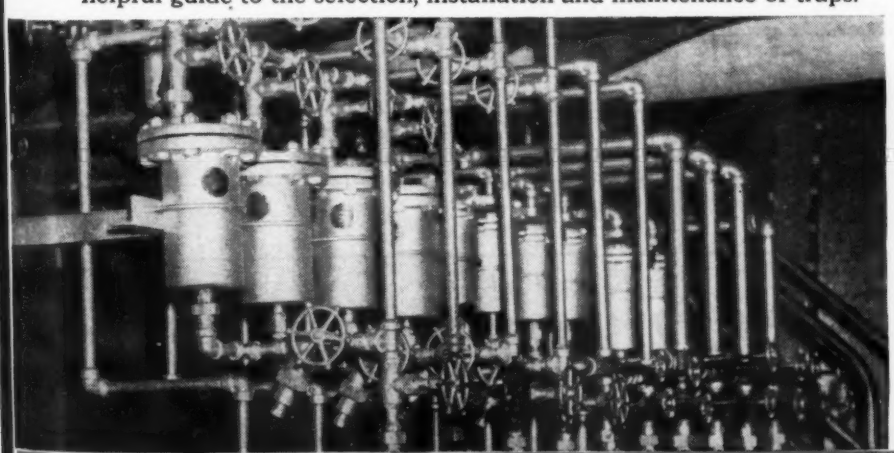
. . . with flanged connections

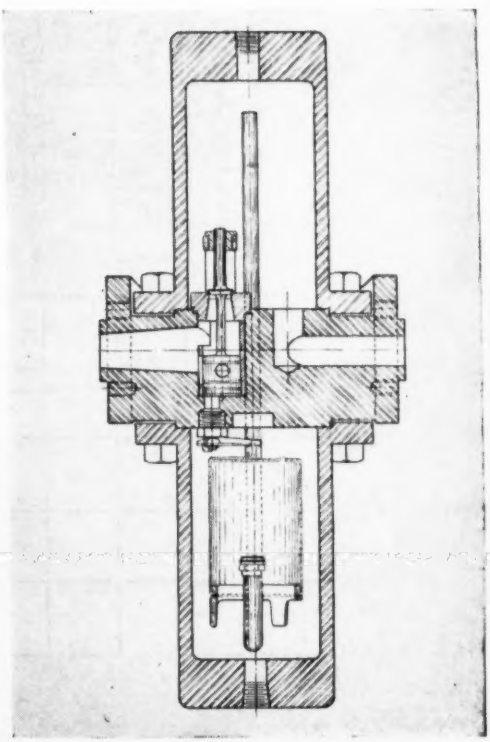
DEVELOPMENT over a period of years of the Armstrong line of forged steel steam traps has gone along with two trends in modern power plant design:

1. Elimination of all cast iron fittings.
2. Completely automatic condensate drainage.

Here are traps engineers like. Simple — dependable. High quality materials. Well designed and well built. A size and type for every application. Backed by nearly 40 years' experience and an unconditional guarantee.

Ask for a copy of the Armstrong STEAM TRAP BOOK, a helpful guide to the selection, installation and maintenance of traps.





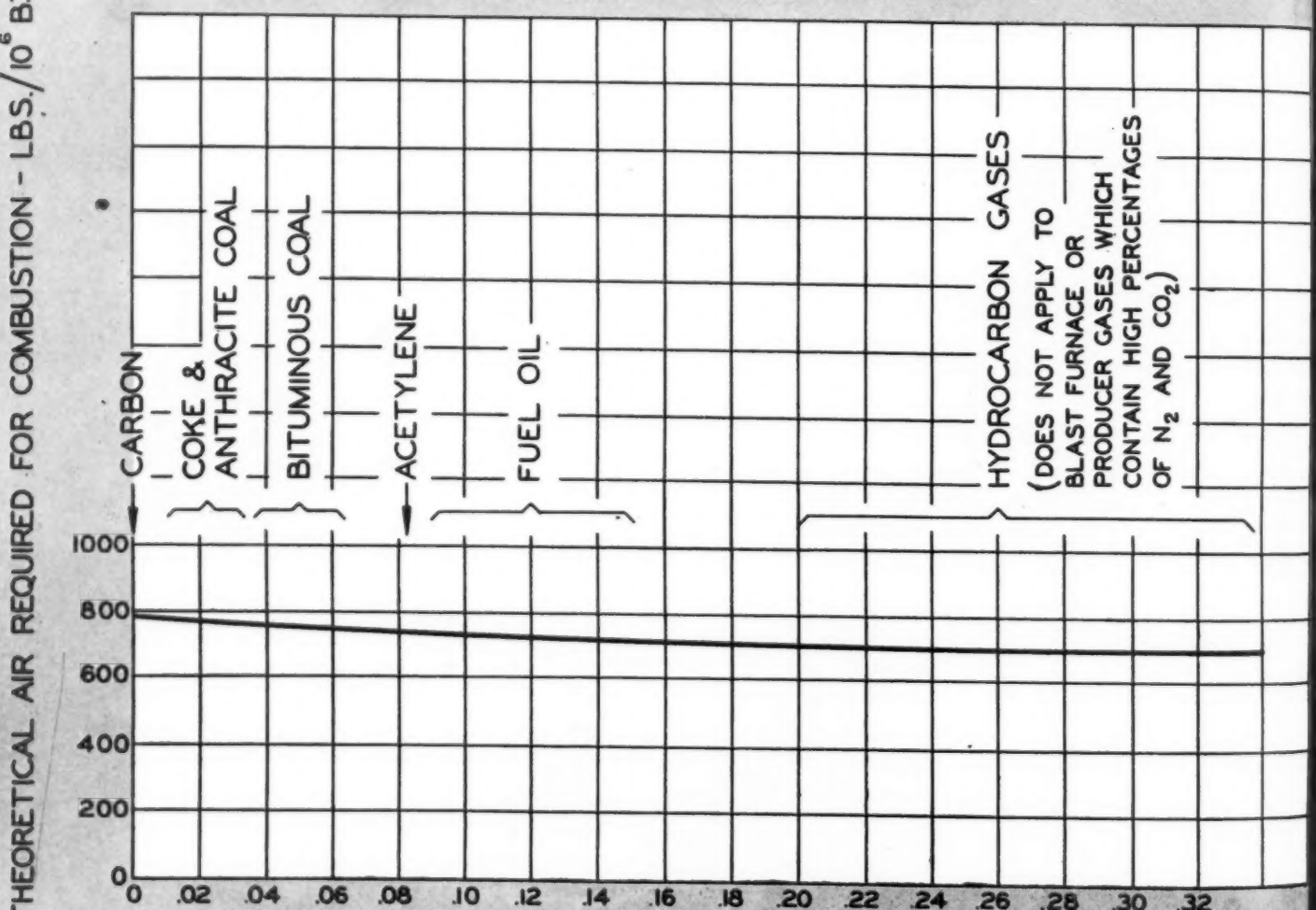
Armstrong Compound Trap

For large amounts of condensate. Capacities to 60,000 lbs. of condensate per hour at pressures to 600 psi. For draining steam purifiers and separators, flash tanks, continuous blow down systems, etc.

MACHINE WORKS

812 Maple Street
Three Rivers, Michigan

3 fuels


THEORETICAL AIR REQUIRED FOR COMBUSTION - LBS./10⁶ B.T.U.'S
CARBON
COKE & ANTHRACITE COAL
BITUMINOUS COAL
ACETYLENE
FUEL OIL
HYDROCARBON GASES
(DOES NOT APPLY TO BLAST FURNACE OR PRODUCER GASES WHICH CONTAIN HIGH PERCENTAGES OF N_2 AND CO_2)
1000
800
600
400
200
0
0 .02 .04 .06 .08 .10 .12 .14 .16 .18 .20 .22 .24 .26 .28 .30 .32
RATIO OF HYDROGEN TO CARBON IN FUEL (BY WEIGHT)

AIR REQUIRED FOR COMBUSTION OF HYDROCARBON FUELS

Relation between heat value of fuel and air requirements. Note how closely a measurement of heat released within a boiler furnace indicates the amount of air required for combustion, not only for any single fuel but even for fuels of widely differing physical characteristics.

HAGAN
HALL
BUROMIN
CALGON

IN VARYING COMBINATIONS

but excess air is correctly maintained

by the HAGAN DIFFERENTIAL MASTER SYSTEM

A large refinery burns refinery gas, oil and mercaptan gas, sometimes singly, sometimes two, or all three at the same time.

B.t.u. content of the oil is relatively uniform; refinery gas varies both in B.t.u. content and density.

Yet—by the Hagan Differential Master method of automatic combustion control, *excess air is correctly controlled* in spite of all fuel changes.

B.t.u. input is automatically adjusted to load demand by the usual Steam Header Master Sender. The Differential Master Sender utilizes the boiler itself as a calorimeter of heat input to control air flow. In this installation, *the heat input of all fuels in use at any instant is automatically totalized by the boiler itself, and the air flow is controlled accordingly.* Control is positive and direct; there is no lagging corrector system.

Automatic control by other methods requires extensive and complicated apparatus, and is commercially impracticable because of cost and operating difficulties.

The Hagan Differential Master method has been thoroughly tested in service. It has been applied to boilers burning oil, gas, pulverized coal and multiple fuels. Boiler sizes range from 30,000 lbs./hr. at 200 p.s.i. to 650,000 lbs./hr. at 1,800 p.s.i. *Every installation* has been entirely satisfactory.

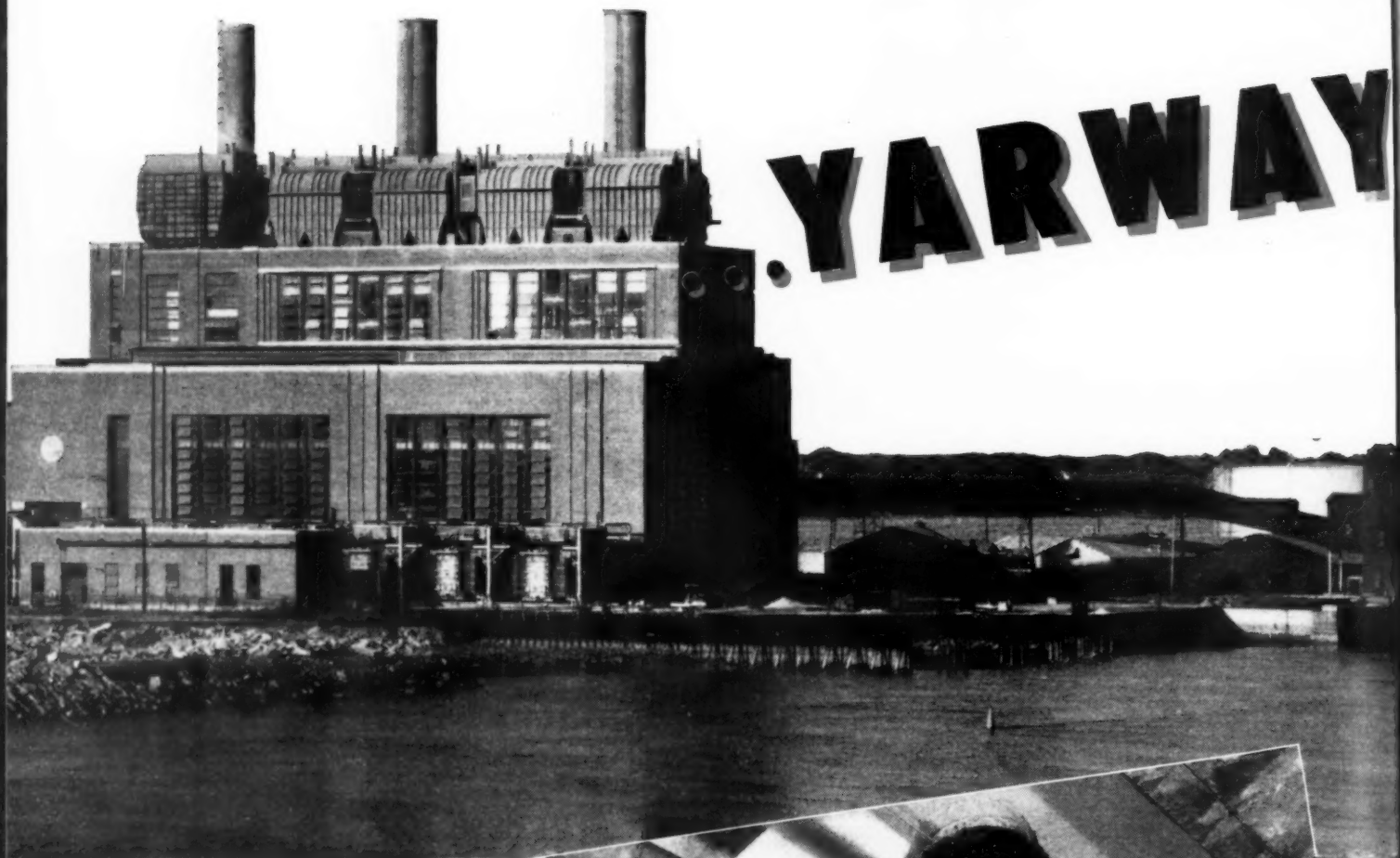
Our engineers will be glad to give you full information.

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

Public Service (N.J.) *Chooses* YARWAY



Burlington, N. J., Station of the Public Service Electric and Gas Company. Four boilers at this plant, and two at Public Service's Marion Station are each equipped with two Yarway Unit Tandems. Steam pressure boiler 1350 psi, turbine 1250 psi. Temperature 950° F. Output, each boiler, 550,000 lbs per hour; high pressure turbines, 115,000 KW each.

YARWAY BLOW-OFF VALVES

UNIT TANDEMS

FOR HIGH PRESSURE BLOW-DOWN SERVICE

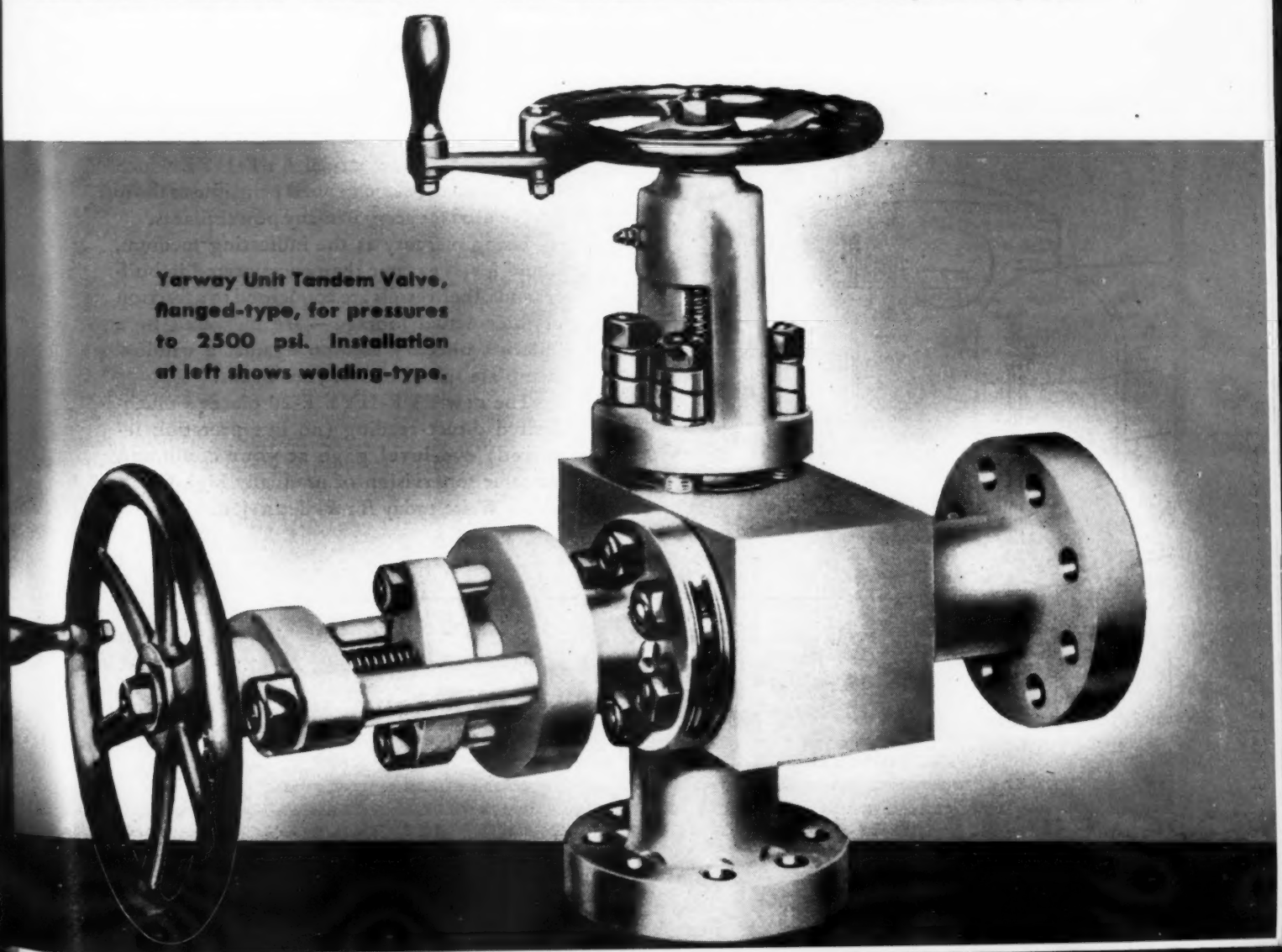
Why has the Public Service Electric and Gas Company of New Jersey, like so many other leading utilities, selected Yarway Unit Tandem Blow-Off Valves for their high pressure boilers? The answer is simple—*proved performance.*

Yarway Unit Tandems have proved themselves unequalled in service throughout all industries on pressures from 400 to 2500 psi. This tandem is a combination of the Yarway Hard-Seat* Valve (next to boiler for blowing) and the famous Yarway Seatless Valve (for sealing)—both contained in a one-piece forged steel body. This rugged construction eliminates the interconnecting flanges, bolts and gaskets required in bolted tandem designs, making a trim, compact unit.

Nearly 40 years of laboratory and field experience concentrated on blow-off valve requirements, makes Yarway a logical source of supply for your next blow-off valves. Write for Catalog B-432 for pressures up to 2500 psi . . . Catalog B-424 for lower pressures.

** Seats furnished either separate or integral.*

YARNALL-WARING COMPANY • 100 Mermaid Avenue, Philadelphia 18, Pa.

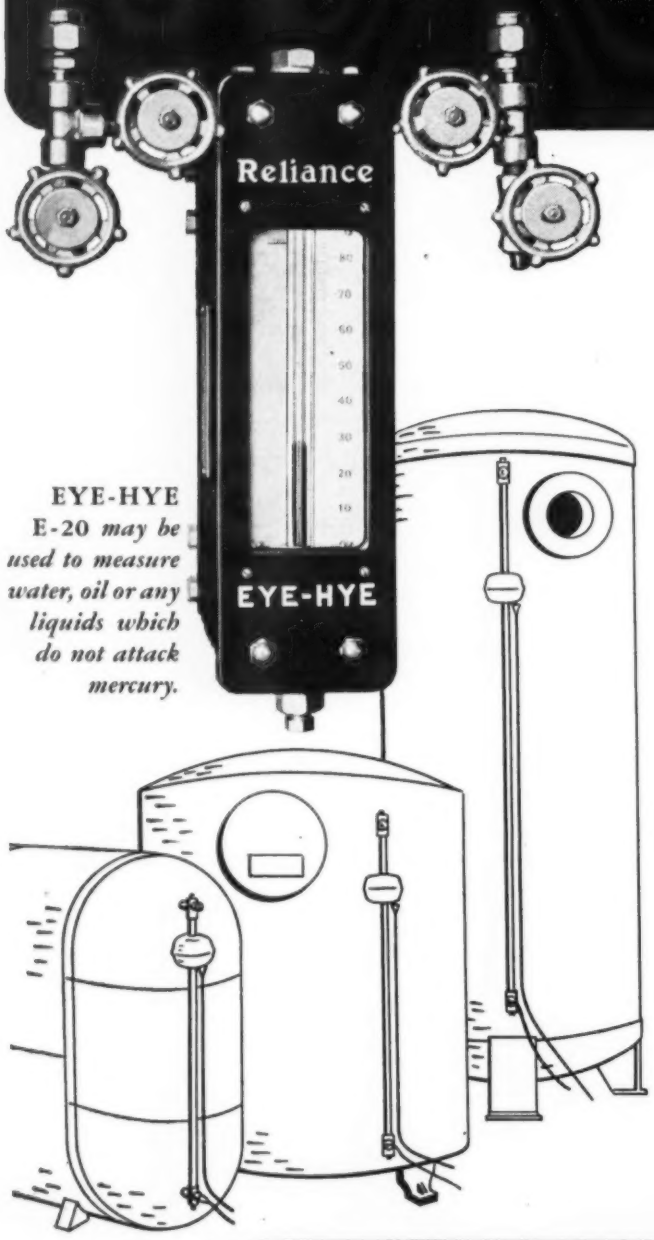


Yarway Unit Tandem Valve, flanged-type, for pressures to 2500 psi. Installation at left shows welding-type.

NEW HIGH LEVEL GAGE

gives you safe accurate reading with remote location convenience

. . . Your tanks and vessels holding liquid levels up to 12 feet now can be read by Reliance EYE-HYE



EYE-HYE E-20 *may be used to measure water, oil or any liquids which do not attack mercury.*

This new model EYE-HYE, the E-20, brings you new convenience and efficiency in checking liquid levels having a high variation factor. It's valuable to know you can read *accurately* up to 12 feet of liquid by a sharply defined, illuminated indicating column no higher than 12 inches. The window can be located above or below and a reasonable distance away from the container — on wall or instrument panel. Reliance has perfected and tested in actual installations this new model EYE-HYE which operates on the same general principle as those you've used (or seen) in many power plants.

Using mercury as the indicating medium, liquid levels greater than encountered in boilers and other vessels are condensed to a fraction of their actual footage — are measured by a "black" mercury column against a window face plate scaled to suit your needs.

The new EYE-HYE E-20 places a much-desired direct-reading (no interpretation required) eye-level gage at your command for safer supervision of unusually high liquid levels. Write today for Bulletin 450.

BOILER SAFETY DEVICES since 1884

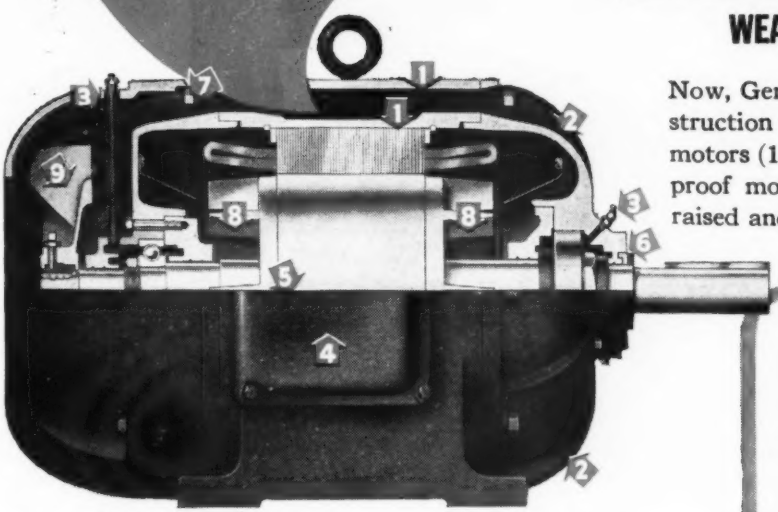
Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

A DOUBLE WALL *Keeps trouble out*

NEW *TRI CLAD* TOTALLY ENCLOSED MOTOR IS MORE FULLY PROTECTED FROM DUST, DIRT, WEATHER, OR WHAT-HAVE-YOU . . .

Now, General Electric has applied Tri-Clad construction to its line of totally enclosed induction motors (1 to 1000 hp) and to most of its explosion-proof motors as well. *Extra protection* has been raised another notch.



FOR EXTRA-SEVERE JOBS

Applications amid dust, metal filings, coolants, or corrosive agents, where totally enclosed motors have always been required, will now have the benefit of a stronger armor, plus convenience features that simplify installation and servicing.

FOR EXTRA-WET LOCATIONS

Indoors or out, these Tri-Clad totally enclosed motors will take hosings or heavy rains without danger of shutdown. The cast-iron frame is strongly resistant to rust and corrosion.

FOR EXTRA LONG LIFE

Many motor users are making the totally enclosed motor their standard for *all* jobs—based on evidence of long-term savings. This new member of the Tri-Clad line makes this decision more logical than ever.

HAZARDOUS ATMOSPHERES

"Companion motors" to the standard Tri-Clad totally enclosed, the new explosion-proof and dust-explosion-proof types are tested and listed by Underwriters' Laboratories for Class I Groups C and D, and Class II Group E, F, and G.

THESE 9 POINTS

of new strength and serviceability put this Tri-Clad totally enclosed motor way ahead

1. A cast-iron, double-wall frame that completely encloses windings and punchings
2. Ribbed cast-iron end shields, machined to provide a tight seal, yet easily removed
3. Well proved pressure-relief greasing systems which can be packed with a long-life lubricant where advisable
4. Cast-iron conduit box diagonally split for wiring convenience (independently explosion-proof on explosion-proof motors)
5. Leads are sealed in a nonshrinking compound at the point where they emerge from frame
6. Rotating, labyrinth seal prevents infiltration of grit or liquids
7. Large, free-flowing, easy-to-clean air passages protect parts from accumulation of dust and foreign matter
8. Modern "ageless" insulation treatment includes Formex* magnet wire
9. Powerful external fan is removable, simplifying maintenance. (Nonsparking type for explosion-proof motors.)

AND IN ADDITION—compactness and short length promote ease of handling and installation.

*Trade-mark Reg. U.S. Pat. Off.

GENERAL ELECTRIC

750-257C-8068

FOR THE COMPLETE STORY

GENERAL ELECTRIC COMPANY
Apparatus Dept., Schenectady 5, N. Y.

Please send me GEA-4400, which describes the new Tri-Clad totally enclosed motor.

Please send me GEA-4131, "Motors and Control for Hazardous Locations."

Name.....

Company.....

Address.....

3893

Repeat Orders PROVE PERFORMANCE

TAYLOR STOKER

AIR-COOLED & WATER-COOLED

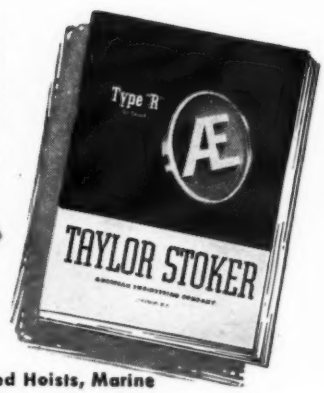
The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within ⅛ inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

One of the country's largest chemical manufacturers is a consistent user of Taylor Stokers. They have installed 11 Taylor Stokers, the first in 1927, generating a total of 1,500,000 lbs. of steam per hour. When a new plant was built to increase production, they again turned to Taylor Stokers. These units are water cooled Type R, have a continuous capacity of 180,000 lbs. per hour and burn strip coal.

Get the Facts on the Improved Type R

This easy-to-read 18 page bulletin will quickly bring you up-to-date on the advantages and improvements in stoker operation as provided by the Æ Taylor Stoker. Write for it!

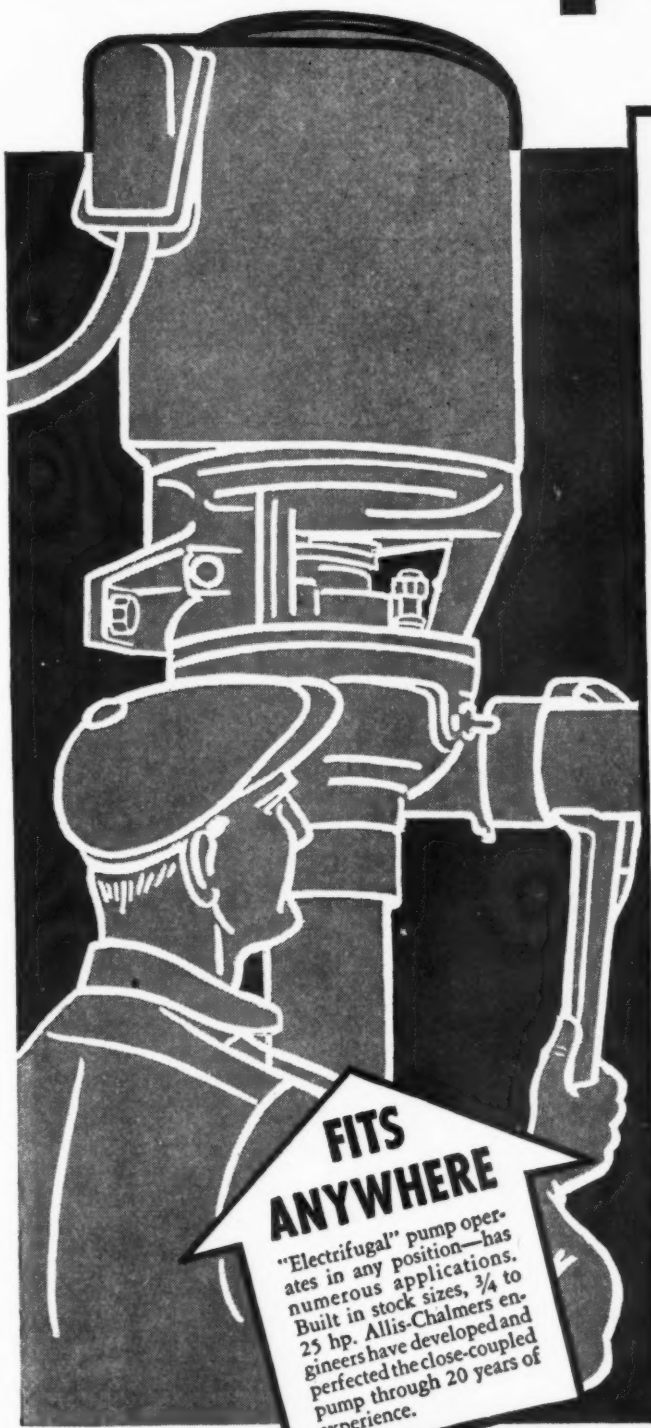


Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

AMERICAN ENGINEERING COMPANY

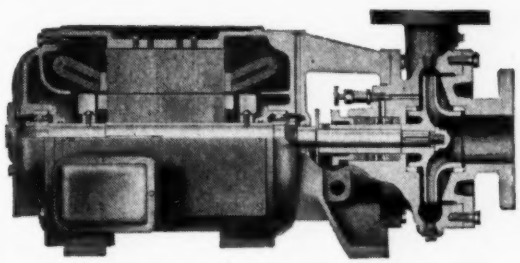
2400 ARAMINGO AVENUE. PHILADELPHIA 25. PA.

Hook Up...AND Pump!



FITS ANYWHERE

"Electrifugal" pump operates in any position—has numerous applications. Built in stock sizes, 3/4 to 25 hp. Allis-Chalmers engineers have developed and perfected the close-coupled pump through 20 years of experience.



A-C "Electrifugal" Pump Cuts Installation Time

This compact "Package" pump comes fully assembled. No coupling to line up. Just bolt it down, make pipe and power connections — prime and pump! More than that, this pump costs you *less to buy — less to operate.* Read these interesting facts:

SIMPLE, COMPACT DESIGN

Motor and pump are built into one rigid frame, with rotor and pump runner on a single shaft. Result: one third less space — fewer parts — *lower cost.*

EASY TO SERVICE

Packings, rotor, impeller, and all moving parts are easy to get at. Quickly taken apart, checked, and reassembled. Down time is reduced to a minimum.

LOW MAINTENANCE

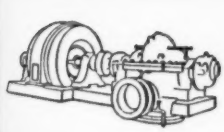
Ample bronze wearing rings, bronze water seal and valve — shaft sleeve and deflector — five packing rings — precision workmanship — and other quality features all add up to longer life, less maintenance cost.

UNDIVIDED RESPONSIBILITY

Allis-Chalmers builds both pumps and motors — backs them up with unsurpassed experience and reputation in both fields. Call your A-C office for help on any pumping problem . . . or write for bulletin B6059. ALLIS-CHALMERS, Milwaukee 1, Wisconsin.

ALLIS CHALMERS

Electrifugal **PUMPS**



COMPLETE LINE

of centrifugal pumps and motors. Single or double suction—single- and multi-stage—capacities to 170,000 gpm.

A 2010

Johns-Manville Announces

Fifty Million Dollar

Multi-Million-Dollar "Test Tube" for actual experimental factory production, as well as fundamental research, now under construction near Bound Brook, N. J. The Johns-Manville Center ultimately will include six large buildings. Innovations in the first unit include ten experimental factories under one roof; a movable rear wall to permit temporary or permanent additions, or to accommodate extra-large machinery; a special system of interior construction to provide flexibility to meet changing needs for laboratory facilities.

Dr. C. F. Rassweiler, Vice-Pres. of Johns-Manville Corporation in charge of research and development, states:

"We are living in an era of scientific improvement unparalleled in man's history. One single development stemming from social and economic needs can bring revolutionary changes throughout an industry. Today, we stand on the threshold of a new era, which has unlimited horizons for the development and improvement of new products for home and industry.

If this goal is to be achieved, some individual or group of individuals must have the imagination, courage and facilities to meet the challenge.

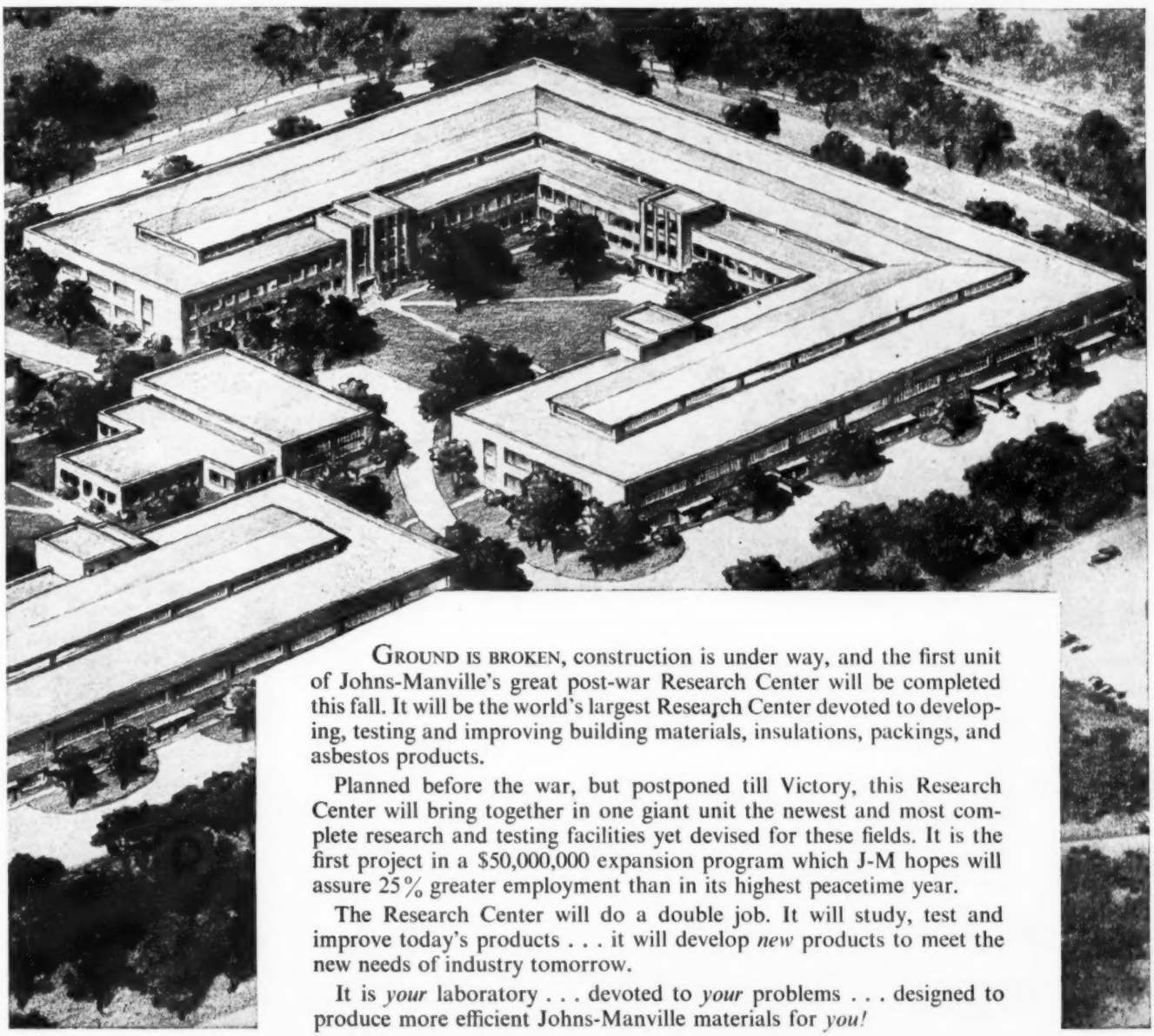
Johns-Manville has accepted this challenge and is now in the process of constructing the world's largest research laboratory devoted to service through science for better homes and greater industrial efficiency."

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

Expansion Program

to include World's Largest Research Center for Building Materials and other Industrial Products



GROUND IS BROKEN, construction is under way, and the first unit of Johns-Manville's great post-war Research Center will be completed this fall. It will be the world's largest Research Center devoted to developing, testing and improving building materials, insulations, packings, and asbestos products.

Planned before the war, but postponed till Victory, this Research Center will bring together in one giant unit the newest and most complete research and testing facilities yet devised for these fields. It is the first project in a $50,000,000 expansion program which J-M hopes will assure 25% greater employment than in its highest peacetime year.

The Research Center will do a double job. It will study, test and improve today's products . . . it will develop *new* products to meet the new needs of industry tomorrow.

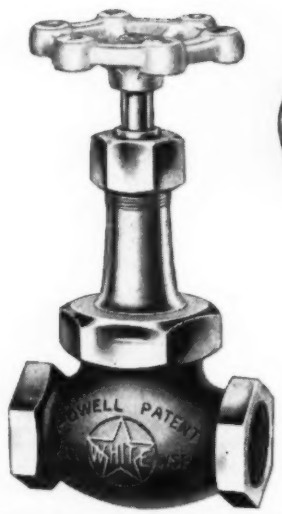
It is *your* laboratory . . . devoted to *your* problems . . . designed to produce more efficient Johns-Manville materials for *you!*

Manufacturers of 1200 Products for Home and Industry

To get *more* for your valve

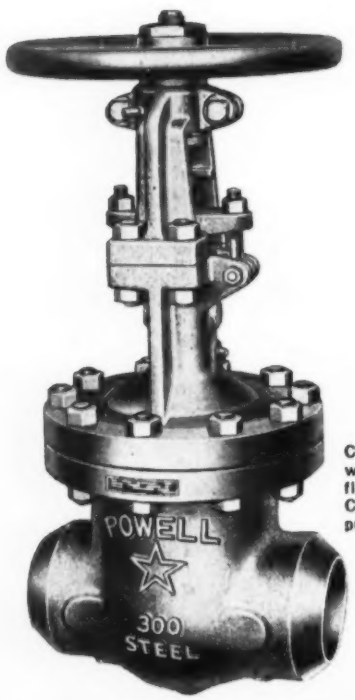
POWELL

No one would expect a burro to pull a load that requires a heavyweight draft horse. But a sure-footed burro is just right for carrying a pack on a mountain trail where the power of a draft horse would be wasted.



Small Bronze Globe Valve for 200 pounds W.S.P. Made in sizes ¼" to 3", incl. Has screwed ends, union bonnet, renewable, specially heat-treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze disc. This is a long-life valve, designed to stand up under severe service conditions.

Class 1500-pound Cast Steel Gate Valve with welding ends, bolted flanged yoke, outside screw rising stem and taper wedge solid disc. Equipped with top-mounted electric motor operator for quick, positive opening and closing by remote control.



Class 300-pound Cast Steel Gate Valve. Has welding ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Powell Cast Steel Valves of all types are available in pressure classes from 150 to 2500 pounds, incl.

POWELL

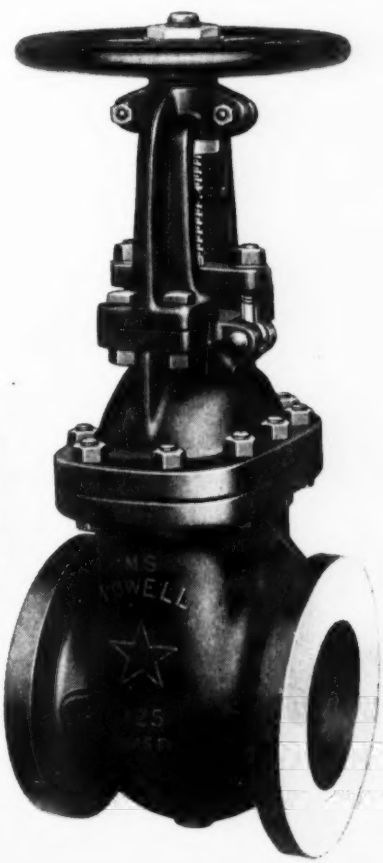
dollar *consult* *Engineering*

And yet when it comes to valves, such "misapplication" is often encountered. *Many cases of failure are directly due to expecting service from a valve which it was not designed to give.* Consequent replacements are costly. On the other hand, it is not sound economy to use a valve of more expensive construction than the particular service requires. The Powell Line* of Bronze, Iron, Cast Steel and Corrosion Resistant Valves, is so *complete* that there's a POWELL valve that's *just right* for every flow control condition encountered in modern industry. When you need valves for new installations or for replacements, don't risk "misapplication". Consult POWELL Engineering and *get more for your valve dollar.*

***In writing for catalogs kindly specify the service conditions under which the valves, in which you are interested, must operate.**

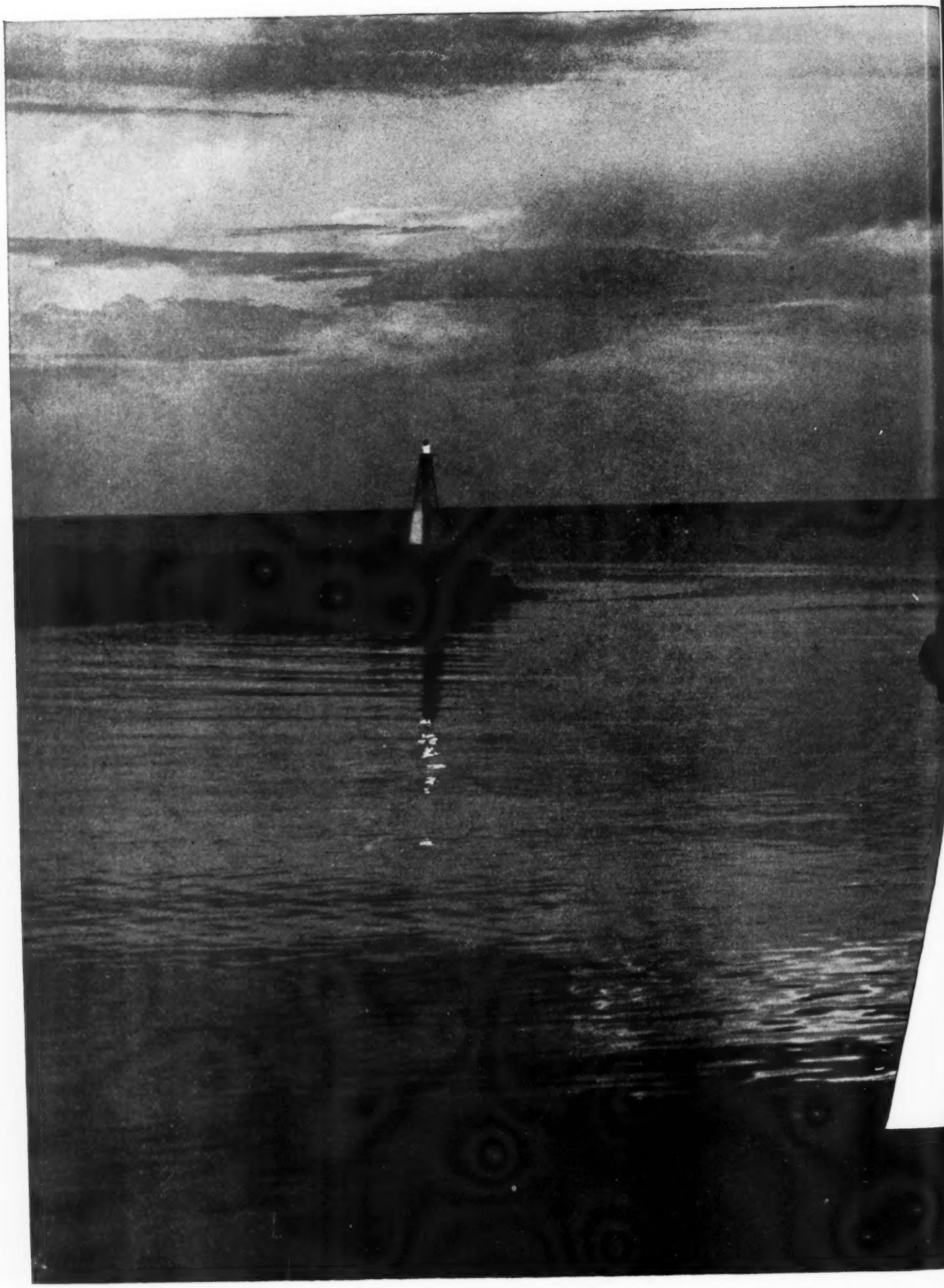
Small Bronze Globe Valve for 150 pounds W. S. P. Made in sizes ⅛" to 3", incl. Has screwed ends and union bonnet. Regularly furnished with renewable vulcanized composition disc for steam service but special discs are available for other services.

Large Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. Made in sizes 2" to 30", incl. Has flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Taper wedge double discs can be provided in sizes 2" to 12", incl. Seat rings and stem are bronze. Disc is bronze in 3½" and smaller size valves and bronze faced in the larger sizes. Also available in All Iron for certain services.



The Wm. Powell Company
Cincinnati 22, Ohio
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES

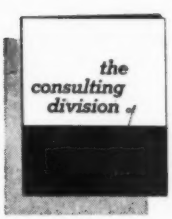


SPECIALIZED CONSULTING SERVICE

The activities of the Betz organization are by no means limited to the regular chemical conditioning and control of boiler and cooling waters. Typical of the completeness and diversification of services offered in the field of water conditioning are those of the Consulting Division. Here is an entirely separate unit, staffed with chemical, mechanical and sanitary engineers, qualified through years of collective experience to make unbiased recommendations for the solution of problems involving the conditioning of industrial or municipal water supplies—or for treatment and disposal of industrial wastes.

Many, if not most water or waste treatment problems are so unique in character as to require study by specialists in order to reach a solution that is both operationally and economically feasible. Such studies made by the staff of our Consulting Division have saved money, effort and production time for hundreds of plants.

The Betz organization has a force of over forty field engineers located in industrial centers throughout this country, Canada and Mexico. These men, at no obligation to you, will be glad to call for a personal discussion of these consulting services, or write to the main office direct for additional details.



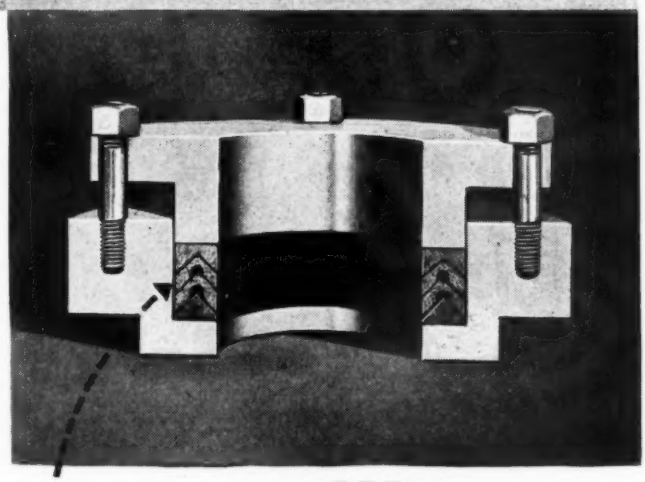
***SEND FOR** the illustrated brochure which gives a complete outline of Betz Consulting Division Services—their fields of application—the manner in which they are extended—and typical functional design drawings of actual treatment plants. Ask for the Consulting Division Booklet-A W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Penna.*

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING
INDUSTRIAL WASTE TREATMENT

Cover photograph from the *Betz Indicator*, a monthly publication devoted to the chemistry and practical applications of water conditioning. The *Betz Indicator* will be mailed without charge at your request.

NOT AN ORDINARY "V" TYPE PACKING



Note the exclusive hinge-like construction

GARLOCK *Chevron* is entirely different from an ordinary "V" type packing. It has an exclusive hinge-like construction which allows the packing to expand as the pressure increases and contract as the pressure decreases. Friction on the rod and on the packing itself is thereby reduced to a minimum. Result: long, dependable service; reduced operating costs. Specify GARLOCK 430 CHEVRON for hydraulic service; 431 for oils at low temperatures; 530 for steam, air or gas; 531 for hot oils.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK *Chevron* PACKING

when cable runs must "run the gauntlet"

a **DELTABESTON*** *cable will give extra assurance of uninterrupted power*

Conditions that shorten the life and threaten the performance of regular types of cable are often unavoidable around the power plant. But that's just where the chances of a cable failure *can't* be allowed to rise.

How can you maintain the same safety factor under *extra severe* conditions that you expect from standard power cable under normal conditions? The answer may lie in a DELTABESTON Cable of special construction, like the one shown here. It's one of many developed to "run the gauntlet" of unusual conditions for central stations and power plants.

Probably, this particular cable is *not* the one you'll need to meet your combination of conditions. In most cases, one of the regular Deltabeston types will do so. But remember that specialists in heat-resisting cable are always "on call" to select or even develop a Deltabeston construction that will maintain an adequate safety-factor for years to come.

* *Trade-mark Reg. U.S. Pat. Off.*

For a copy of the Deltabeston Cable catalog, write Section Y-3-752, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn. Deltabeston Wires and Cables are distributed by G-E Merchandise Distributors.

GENERAL ELECTRIC

15% of a conventional highly refined turbine oil is discarded by the Alchlor Process to produce

GULFCREST OIL

This vital extra refining step makes the difference! After the carefully selected crude oil used in Gulfcrest goes through the major refining methods, including solvent extraction and dewaxing, it is then superrefined by the Alchlor Process.

Here the less stable hydrocarbons are synthesized and reformed by the catalytic action of the "Alchlor." More than 15% of the oil is discarded by the Alchlor Process —this 15% contains the hydrocarbons most apt to oxidize and form sludge, emulsifiers, and harmful acids.

That's why Gulfcrest is incomparably pure—why it gives outstanding performance, and lasts indefinitely.

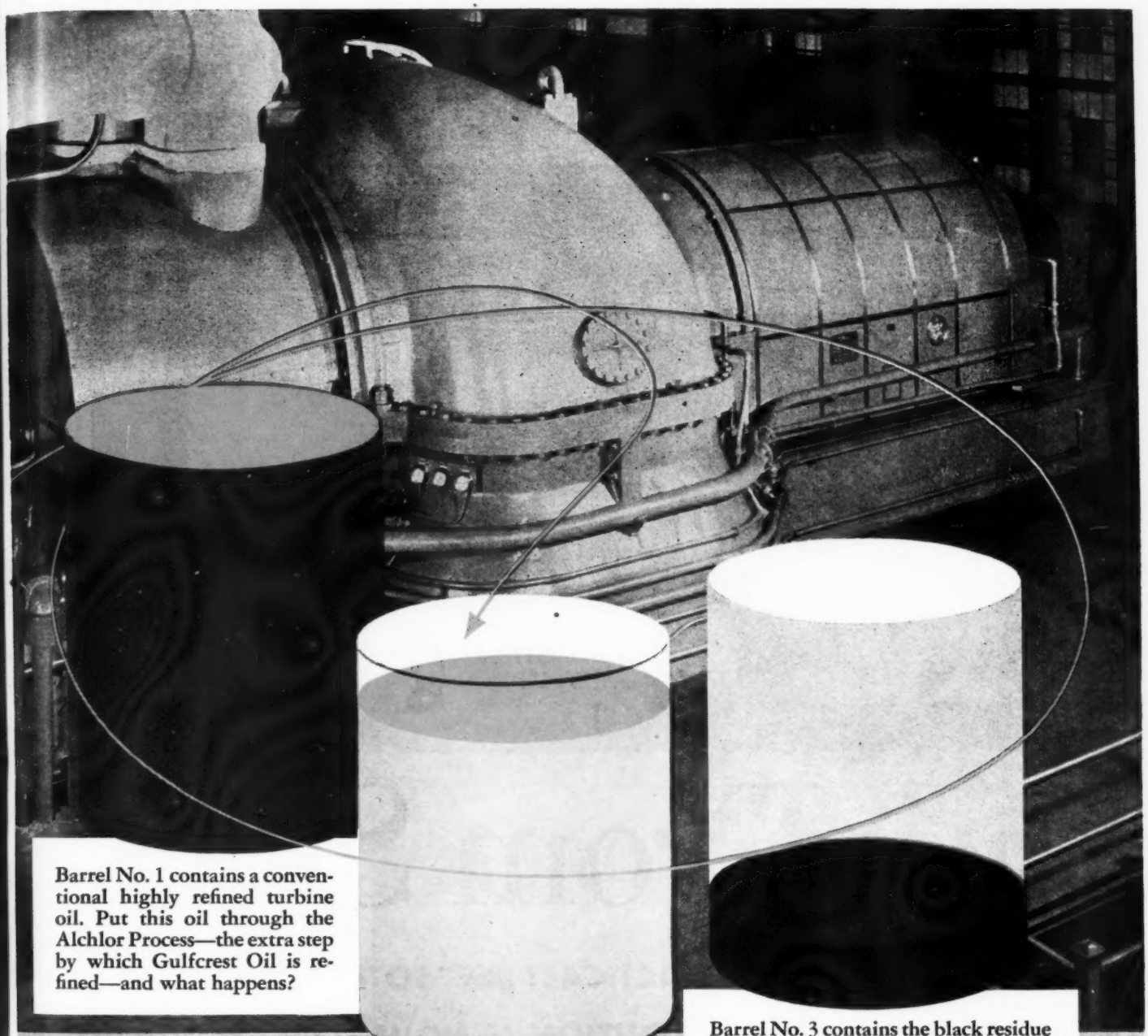
Call in a Gulf Lubrication Service Engineer today and ask him to recommend the proper grade of Gulfcrest Oil to provide the best lubrication for your turbines. Write, wire, or phone your nearest Gulf office.

Gulf Oil Corporation • Gulf Refining Company

Division Sales Offices:

Boston · New York · Philadelphia · Pittsburgh · Atlanta
New Orleans · Houston · Louisville · Toledo

GULF INDUSTRIAL LUBRICATION



Barrel No. 1 contains a conventional highly refined turbine oil. Put this oil through the Alchlor Process—the extra step by which Gulfcrest Oil is refined—and what happens?

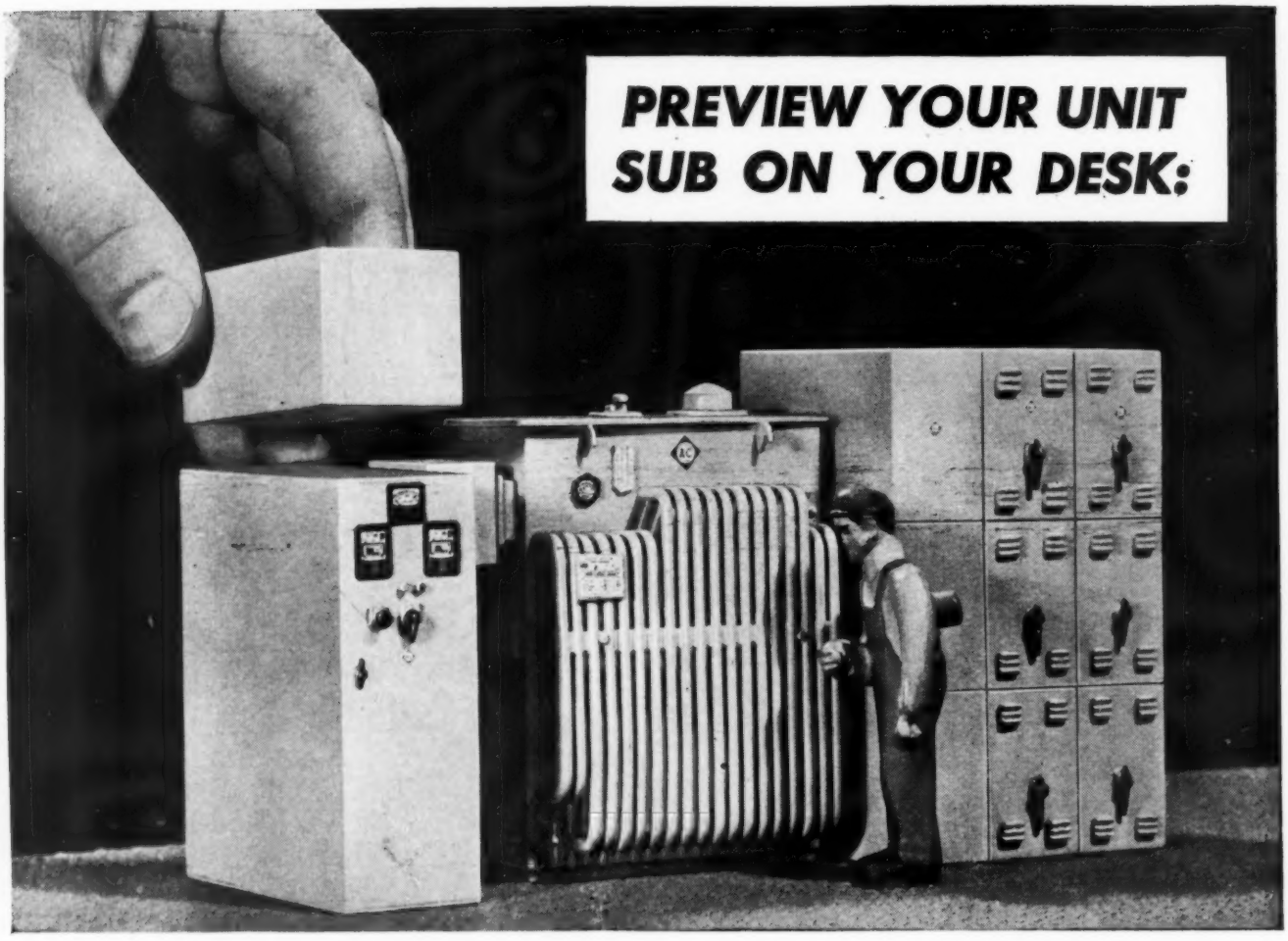
Barrel No. 2 gives the answer. Only 85% of the volume remains—a pure, cleaner, more highly refined turbine oil, with a more homogeneous, tougher film of higher lubricating value. 15% has been discarded by the Alchlor Process.

Barrel No. 3 contains the black residue which has been removed from the mixture by the Alchlor Process. It is largely made up of semi-lubricating waste that may eventually form harmful products, such as sludge, emulsifiers, and acids.

Why Gulfcrest is the world's finest turbine oil

1. Gulfcrest Oil is not only refined by conventional methods, but is superrefined by the Alchlor Process, which weeds out the sludge formers — the undesirable hydrocarbons — in oil.

2. The Gulf Alchlor Process imparts to Gulfcrest Oil greater ability to benefit from the addition of special inhibitors which control oxidation and prevent increase of viscosity.



Buy From Sight,

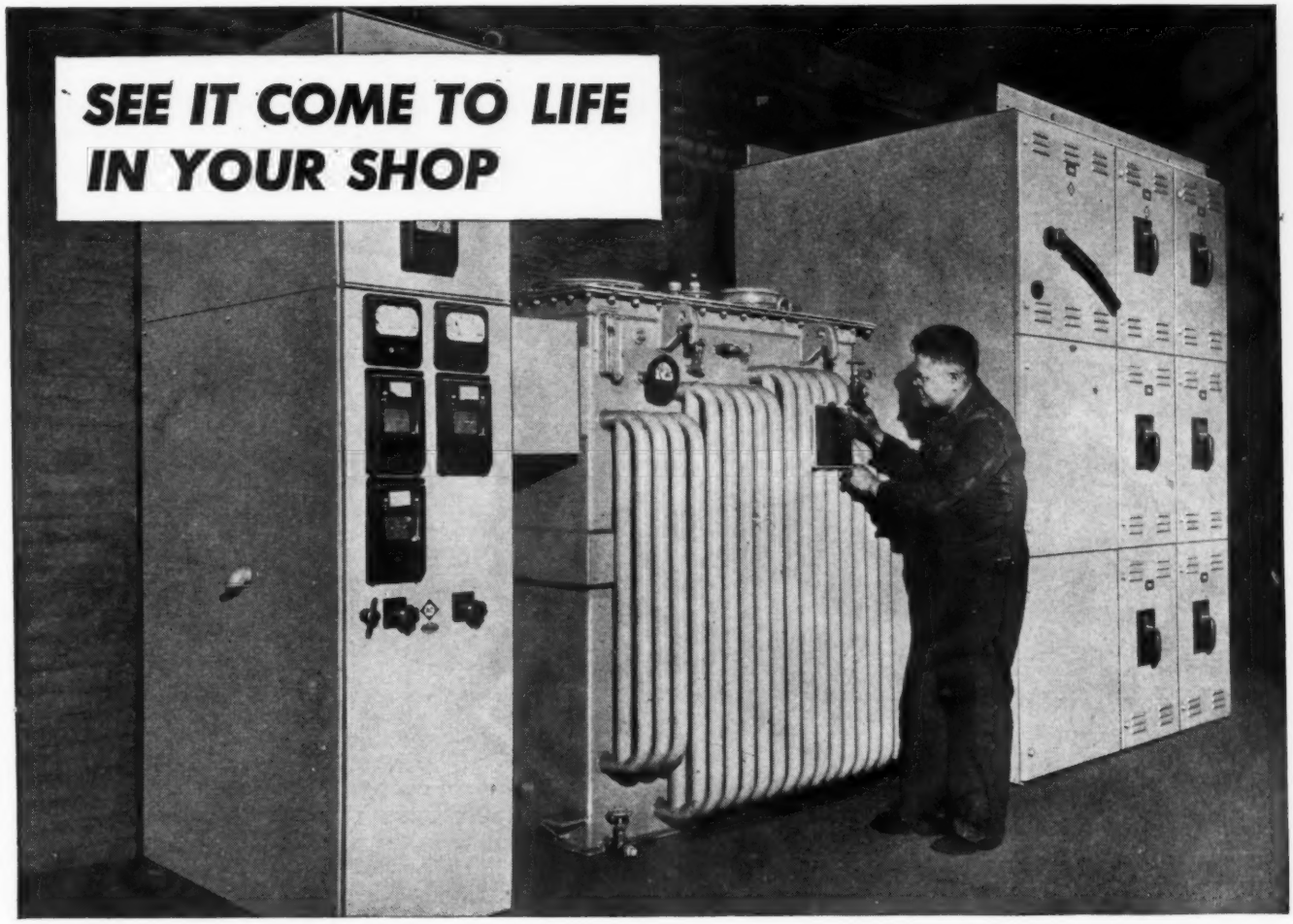
SO SIMPLE! SO PRACTICAL! SO FAST! — VISUAL PLANNING OF POWER DISTRIBUTION IS NOW POSSIBLE WITH THE HELP OF ALLIS-CHALMERS' "UNIT SUB BUILDER" SET. YOU SEE WHAT EQUIPMENT IS AVAILABLE, HOW IT FITS TOGETHER, HOW THE RIGHT UNIT SUB WILL LOOK IN YOUR PLANT.

NO LONGER is it necessary to bog down in complicated charts and tables while solving power distribution problems.

With the help of Allis-Chalmers' "Unit Sub Builder" Set you can now plan visually, effortlessly, quickly. You can *see* what equipment is available, experiment with various arrangements, make comparisons, build solutions . . . *right on your own desk top.*

What's more: A-C models, accurately scaled ½ inch to 1 foot, are good insurance against costly power distribution planning mistakes. They make it possible for you to *pre-test* your unit sub ideas . . . let you see just what you're getting in terms of dimensions, characteristics, appearance.

You'll get an even clearer picture if models are built up



and Buy Right!

on a floor plan of your plant drawn to the same scale.

All of the elements making up Allis-Chalmers Prefabricated Load Center Unit Substations are contained — in miniature — in the model kit. In addition, there's a "Unit Sub Slide Rule" to simplify breaker calculation and a valuable "Unit Sub Check List" to give you the added planning safety of a double check.

In the comparatively short period Allis-Chalmers' "Unit Sub Builder" Set has been available for assisting power distribution planners, engineers of many leading U. S. firms have taken advantage of its time-saving, trouble-saving benefits. They like the idea of working out solutions to unit sub problems . . . quickly, easily, accurately.

This complete *and proven* service is yours with no obligation. To see for yourself how the models, check list, and slide rule can help you in planning your power distribution system, call your nearby Allis-Chalmers district office.

An A-C field engineer will bring the "Unit Sub Builder" Set, together with the handy slide rule and check list to your office for a showing. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1952

—with

ALLIS-CHALMERS

Unit Sub Builder Set

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

At little or no extra cost

Get Double Protection

against Motor Burnouts from Overloads or Single Phasing by installing

FUSETRONS

OF COURSE, larger motors are protected with thermal cutout or overload relays. They save many motors, but experience shows that such mechanical devices sometimes stick or fail to operate—and a motor burns out.

You can give motors DOUBLE PROTECTION against burnout from SINGLE PHASING or any dangerous electrical OVERLOAD, simply *by replacing fuses used for short-circuit protection with Fusetrons* of motor-running protection size.

Fusetrons give same short-circuit protection as fuses and should thermals or relays fail to operate for any reason the Fusetrons will act independently to save the motor.

● *Why this double protection COSTS LITTLE OR NOTHING*

Large size fuses are replaced with SMALLER size Fusetrons. This means a step down in the price range.

For example: The lowest cost 100 amp. 250 volt fuse costs approximately $0.34. A 60 amp. Fusetron to replace it costs about $0.30—(BUSS Fuse Reducers to make the change possible costs but little and need never be replaced).

That is why you need not worry about the cost of replacing fuses with Fusetrons even though installing Fusetrons means that you REDUCE MANY MANY TIMES THE CHANCE OF HAVING A MOTOR BURN OUT.

On new installations you ACTUALLY SAVE MONEY because proper size switches or panels are installed instead of oversize equipment needed to take fuses large enough to hold motor starting current. The smaller size Fusetrons used further reduce costs.

● *Why Fusetrons Can Give Motor-Burnout Protection*

Fusetrons have a tremendous time-lag, due to combining a thermal cutout with a fuse. This means they can be used in a size close to the actual running current of the motor because they will not open on the motor starting current.

Ordinary fuses or circuit protection devices—because they lack sufficient time-lag, must be installed oversize to prevent their opening on the motor starting current. They can give only short-circuit protection to the wiring. They cannot operate to protect either the motor or the starter until the current flowing is far in excess of the motor-running current.

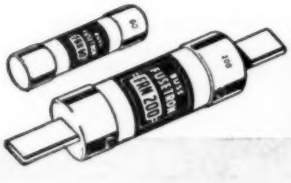
But when Fusetrons of proper size are used, any current dangerously in excess of the normal motor-running current will cause them to open. Thus they back up the overload device already installed They double the protection the motor has against burnout.

● *Provide simplest way to prevent damage from Single Phasing*

When single phasing occurs, the current flowing through the motor and through the Fusetron in the remaining phase increases about 100%. (Theoretically 73% but change in efficiency and power factor make it about 100%).

This 100% overload on Fusetrons of motor-running protection size opens them and stops the flow of current.

So to be DOUBLY SURE that motors won't be lost should single phasing occur, just replace fuses used for short-circuit protection with Fusetrons of a size near to the actual running current of the motor.



BUSS

HERE'S PROOF *Records of Joslyn Mfg. & Sy. Co., Chicago, show that . . .*

Fusetrons PREVENT MOTOR BURNOUTS

"In our plant we have 710 motors, ranging in size from 1/60th to 450 h. p. Before 1938, we used renewable fuses in all circuits, with thermal relays for individual motor protection.

"Beginning in 1938, we changed all our fuses to Fusetrons, using regular fuse sizes in mains and feeders and motor protection sizes in the motor circuits. Our records show that for the 12 months ending August 31, 1945, we had only two motor burnouts, both on the same motor. This is a 2 horsepower motor driving an electric hoist with an actual load of about 3 horsepower. Therefore, we are unable to operate the motor if we use the correct size Fusetron to protect it, and since we have been unable to get a 3 horsepower motor to replace it, due to mechanical features, the only thing we could do was let this motor run overloaded and eventually burn out.

"Our Electrical Department keeps a complete record on blown Fusetrons, giving full details on each blow, with a place for remarks by the maintenance man who makes the replacement. These records show that for the month of August, 1945, we blew 63 Fusetrons, ranging in size from 2-¼ ampere to 100 ampere, representing 43 shutdowns. From the remarks made by the maintenance men on their reports, it seems likely that probably half of these shutdowns would have resulted in burned out motors had the Fusetrons not blown."

Peter Joyce, Chief Electrician,
Joslyn Manufacturing & Supply Co.,
Chicago, Illinois

What is the FUSETRON?

The Fusetron is a DUAL element device—A Fuse to which is added a Thermal Cutout.

The result is a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratories approval for both motor-running and circuit-protection as the most expensive devices made. Fit standard fuse blocks.

Fusetrons are made to same dimensions as ordinary fuses and fit all standard fuse holders.

They are obtainable in all sizes from 1/10 to 600 ampere—in both 250 and 600 volt types.

Also obtainable in plug type and Tamper-resisting type (Fustats) for 125 volt circuits.

Their Cost is Surprisingly Low.

Fusetrons Protect Against Work Stoppage in Many Ways if Installed Throughout the Entire Electrical System

★ ***Entirely wipe out needless blows caused by motor starting currents or other harmless overloads***

Fusetrons have tremendous time-lag. They hold 500% load more than ten seconds whereas most sizes of ordinary fuses blow in less than one second. They won't open on starting currents or harmless overloads (heavy overloads for a short time or light overloads for a longer time). Fusetrons won't shut down a circuit needlessly.

★ ***Give thermal protection to panelboards and switches***

The thermal cutout in Fusetrons opens at 280° F. Thus if poor contact heat develops from any cause, the circuit is opened and heating stopped before damage can be done.

Ordinary fuses can't so protect because the temperature of the link must reach 786° F. before it will melt out.

Fusetrons warn that maintenance is needed instead of permitting panel or switch to be damaged by poor contact.

★ ***Prevent needless blows caused by heating in panels and switches***

Fuses have 55 to 140% greater electrical resistance at full load than Fusetrons, hence Fusetrons produce less heat than any fuses. They eliminate useless shutdowns caused by fuses running too hot.

★ ***Permit use of larger motors or adding more motors on circuit WITHOUT installing larger switch or panel***

The operating load on Fusetrons can be close to their ampere rating because Fusetrons hold starting currents—but ordinary fuses must be installed oversize because they lack sufficient time-lag to hold starting currents.

By replacing oversize fuses with Fusetrons, you can load panels or switches near their capacity. A larger motor or additional motors can be installed without the trouble or expense of changing the panel or switch.

★ ***On new installations, use Proper size switches and panels instead of oversize***

With ordinary fuses, switches and panels must be oversize because fuses larger than the operating load must be used to hold starting currents.

But Fusetrons hold starting currents, therefore, PROPER size switches and panels to fit the load can be installed, saving money and space.

★ ***Double burnout protection for large motors (See opposite page)***

★ ***Make protection of SMALL motors simple and inexpensive***

Install a Fusetron of proper size anywhere in the circuit to handle ONLY the motor current—that's ALL—to safeguard against trouble and cost and lost work caused by the burnout of even a SMALL MOTOR.

★ ***Protect coils, transformers and solenoids against burnout***

Install a proper size Fusetron. It won't open on harmless overloads or normal current surges, yet should a dangerous overload occur for any reason it will cut off the current to prevent a burnout.

GET ALL THE FACTS

Get Better Protection—Send The Coupon Now

Even one lost motor or one needless shutdown or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses. Change over the whole plant to Fusetrons.

BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo.

746

Bussmann Mfg. Co. University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about BUSS Fusetrons.

Name_____

Title_____

Company_____

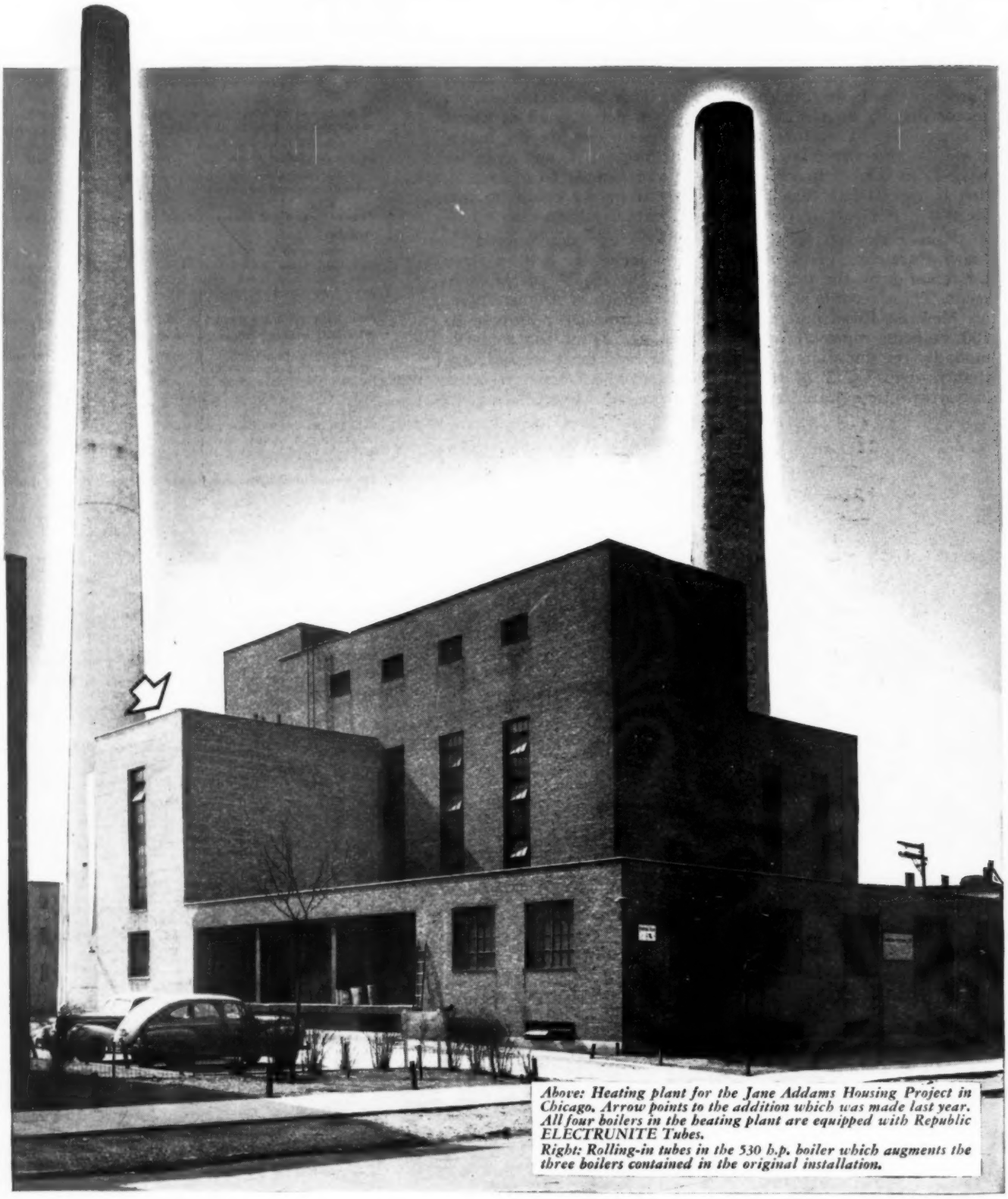
Address_____ State_____

City_____

FUSETRONS

SOLD THROUGH WHOLESALERS

in CHICAGO



Above: Heating plant for the Jane Addams Housing Project in Chicago. Arrow points to the addition which was made last year. All four boilers in the heating plant are equipped with Republic ELECTRUNITE Tubes.
Right: Rolling-in tubes in the 530 h.p. boiler which augments the three boilers contained in the original installation.

it's ELECTRUNITE

...IN NEW HEATING PLANT ADDITION AT JANE ADDAMS HOUSING PROJECT

ELECTRUNITE Boiler Tubes are not new to engineers at the $5,000,000 Jane Addams Housing Project in Chicago. In the original heating plant installation, made in 1937, they were included in the three 400 h.p., 100 lbs. pressure, 388° temperature boilers.

Again in 1945, based on the performance of the original tubes in actual service, ELECTRUNITE Tubes were specified for the 530 h.p. boiler in a new heating plant addition.

Daily, in this and countless other installations of all types, Republic ELECTRUNITE Boiler Tubes are proving that they've got what it takes for fast, efficient installation—for dependable, trouble-free operating performance. And not without good reason, too!

As produced by Republic's process of electric resistance welding and full normalizing, these *modern* boiler tubes are consistently uniform in wall thickness, diameter, roundness and ductility. They are FREE from trouble-inviting scale and scale pits. That each tube is strong and sound—*throughout wall and weld*—is evidenced by rigid hydrostatic testing at pressures in excess of code requirements.

For every installation, *no matter how severe the service,* it will pay you to investigate the many profitable advantages afforded by long-lasting Republic ELECTRUNITE Boiler Tubes. Complete information on request. Write to:

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STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
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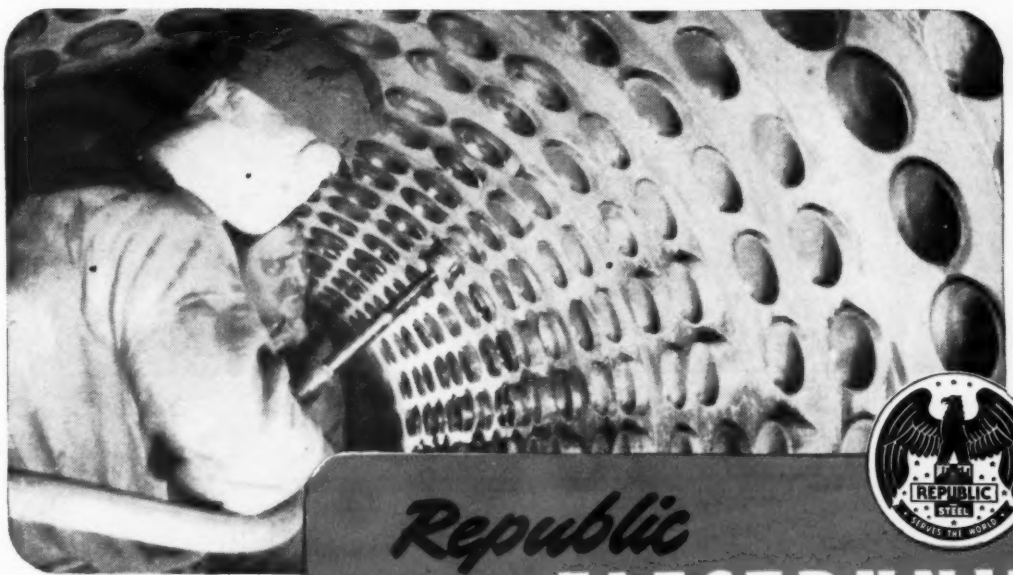


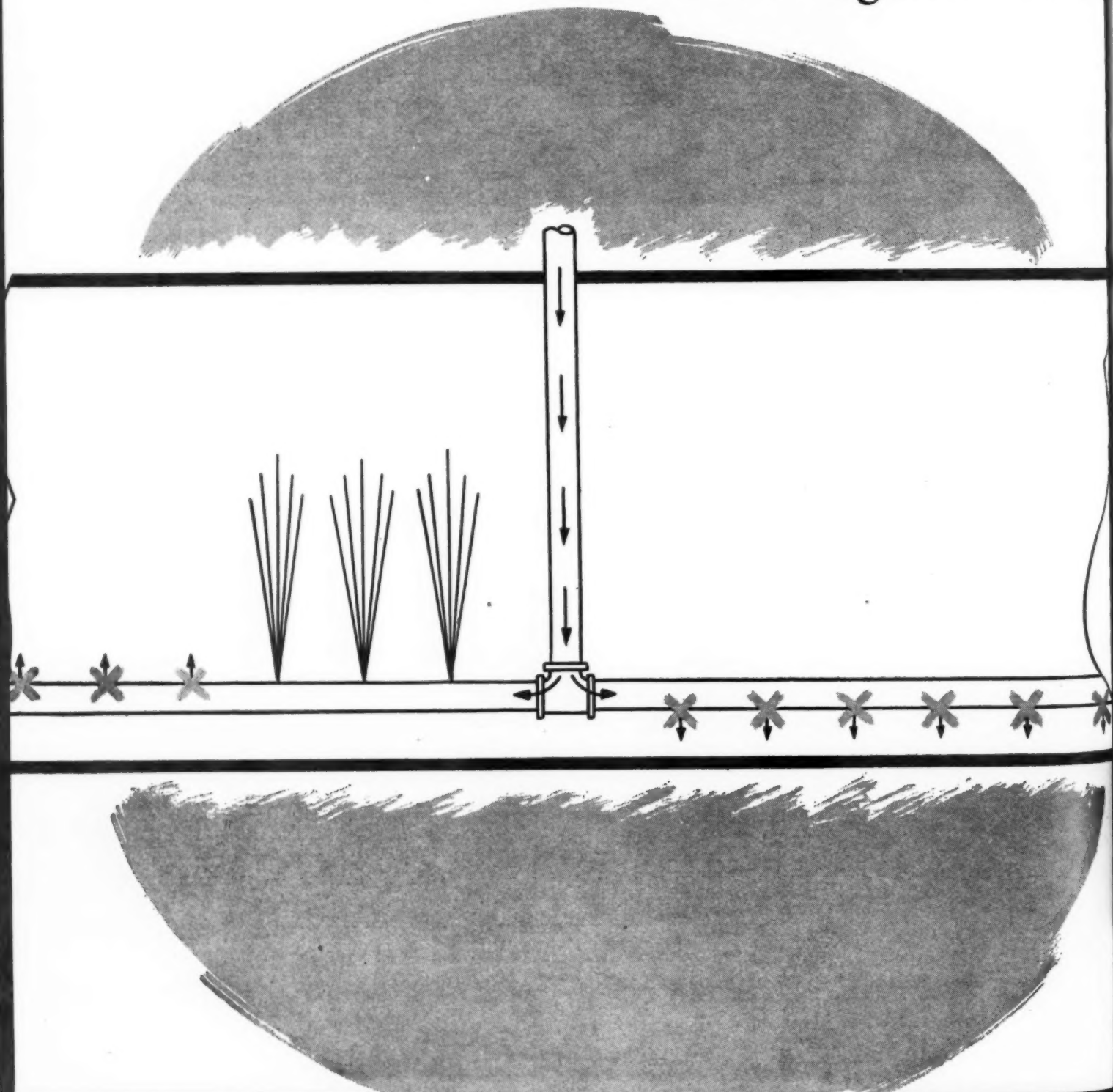
Photo courtesy of Lasker Boiler and Engineering Corp.

Republic
ELECTRUNITE
Reg. U. S. Pat. Off.
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Boiler water conditions seemed

satisfactory . . . but tube losses continued

. . . until the **Hall Engineer** *went in*



Following trouble-free operation for a number of years, one boiler in an eastern refinery suffered losses of water wall tubes with exasperating regularity.

Analyses of deposits from the tubes showed some evidence of undertreatment with phosphate, but boiler water analyses showed normal conditions. This suggested the possibility of boiler water samples not being representative but an inspection of the boiler by the Hall engineer was necessary to determine *why*.

into the boiler

Examination of the feed water distributing system quickly revealed the source of the trouble. The arrangement was a common one—a pipe through the top of the steam drum to a tee below the water level, with a perforated branch line extending from each end of the tee.

In the right hand branch, facing in the direction of firing, the perforations were on the under side of the pipe—and every one was completely clogged. In the left hand branch the holes were on the upper side of the pipe, but of thirteen perforations, only the three nearest the tee were open.

Obviously, there was certain to be maldistribution of feed water and chemical, with consequent deficiency in treatment in certain sections of the boiler. Scale developed on tube surfaces, flaked off, and accumulated in the bends of the water wall tubes.

To correct the trouble it was only necessary to remove and clean the clogged pipes, which were then replaced with all perforations on the upper side.

On this job, the source of tube trouble was quickly removed because the Hall service engineer knew how to interpret the conditions indicated by the deposits and boiler water analyses.

"Trouble shooting" such as this is an important part of Hall service but of even greater importance is the prevention of trouble. Hall Laboratories have an outstanding record in both of these tasks.

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HALL SYSTEM *of Boiler Water Conditioning*

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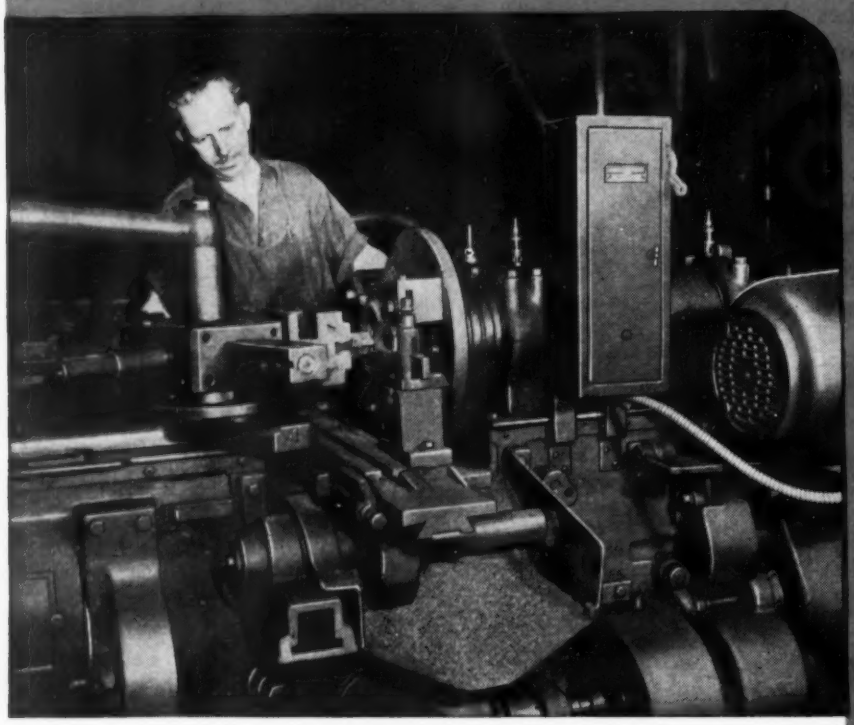

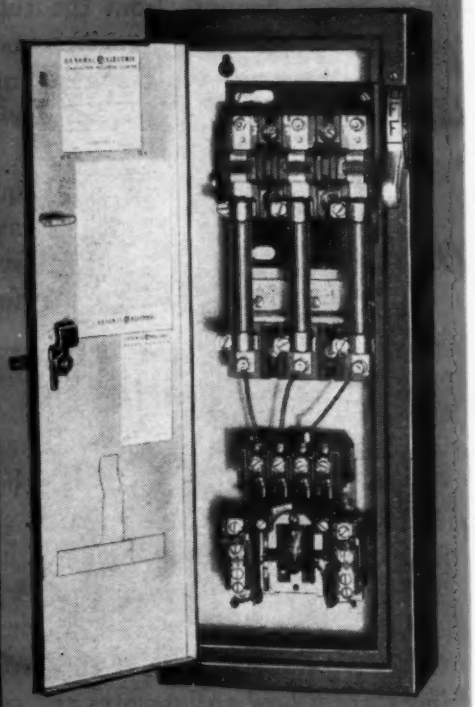

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Magnetic starter and motor-circuit switch in *one* unit—G-E "combination" motor starters of this type give co-ordinated control to over 300 machines in the White Motor Company plant in Cleveland.

The starter shown above is installed on a lathe used in making water pumps. Others control drill presses, shapers, boring mills, grinders, and many other types of machines.

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- Safety for operators is assured by interlocking doors. While the power is on, the door cannot be opened.
- Quick servicing and availability of repair parts is made possible by G.E.'s broad network of sales outlets.

Wide Field of Application

This motor company represents just one of the many different industries in which G-E combination starters are at work today. Why not give the advantages of these compact, time-saving starters to *your* plant. Our engineers will be glad to help with your application. Get in touch with our local office today. ***Apparatus Dept., General Electric Company, Schenectady 5, N. Y.***

GENERAL ELECTRIC

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MORE INFORMATION about combination starters is given in our Bulletin GEA-3715A. Ask our local office for your copy.

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After he has subjected a problem of handling bulk material to a rigorous "third degree"... *after* he has exposed its smallest detail to the penetrating light of searching analysis—*only then* is an S-A engineer ready to work out the solution.

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Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

IRON FIREMAN

is more than a word

HERE ARE THE REASONS:

In the Combustion Zone

No part of the Iron Fireman Pneumatic Spreader stoker is subject to the direct heat of the combustion chamber. What this means in terms of low maintenance costs can be readily appreciated by any combustion engineer.

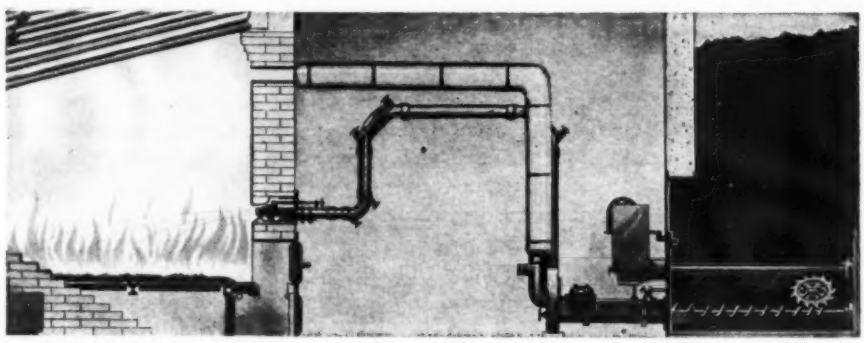
As can be seen in the accompanying sketch, the only stoker part inside the furnace above the grate line is the coal nozzle, which is constantly surrounded by currents of cooling air admitted through an adjustable vent.

The pneumatic spreader grates themselves, which are an exclusive Iron Fireman feature, are likewise fully protected. Integral cooling fins on stationary grate sections conduct heat away from the upper surfaces. Dumping grates are so designed that a protective ash coating remains on the top surface, even when sections are in a dumping position. This feature, together with the cooling fins on the under side of the grates, protects them from excessive heat. An ingenious arrangement of lateral air ports, in conjunction with the residual ash on the upper grate surface, diffuses the air over the entire grate surface, giving higher combustion efficiency.

In the Conveyor Zone

All moving parts connected with feeding and conveying of coal are located near the coal supply, entirely separate from the boiler and unaffected by furnace heat. The conveyor system is very simple in operation. It includes motors, power transmission, coal pick-up and transfer mechanism, and conveyor fans. These parts are readily accessible for easy inspection and maintenance. A further reason for Iron Fireman dependability is the ample margin of strength built into all Iron Fireman equipment.

That Iron Fireman's careful engineering pays out in practice is proved by records of thousands of installations in which low fuel costs are combined with exceptionally low maintenance and thorough dependability.



THE IRON FIREMAN PNEUMATIC SPREADER STOKER meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by pneumatic conveyor and delivered to furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which do not preheat fuel.

Heavy Duty Automatic Coal Stoker for Power Processing and Heating

DEPENDABILITY

–it is a *FACT*

Plant of the Sulloway Hosiery Mills, Franklin, N. H. (Above) Two boilers in the Sulloway plant fired by Iron Fireman Pneumatic Spreader stokers.

Iron Fireman stoker reduces fuel costs, increases production, is more dependable, says Sulloway Hosiery Mills, Franklin, N. H.

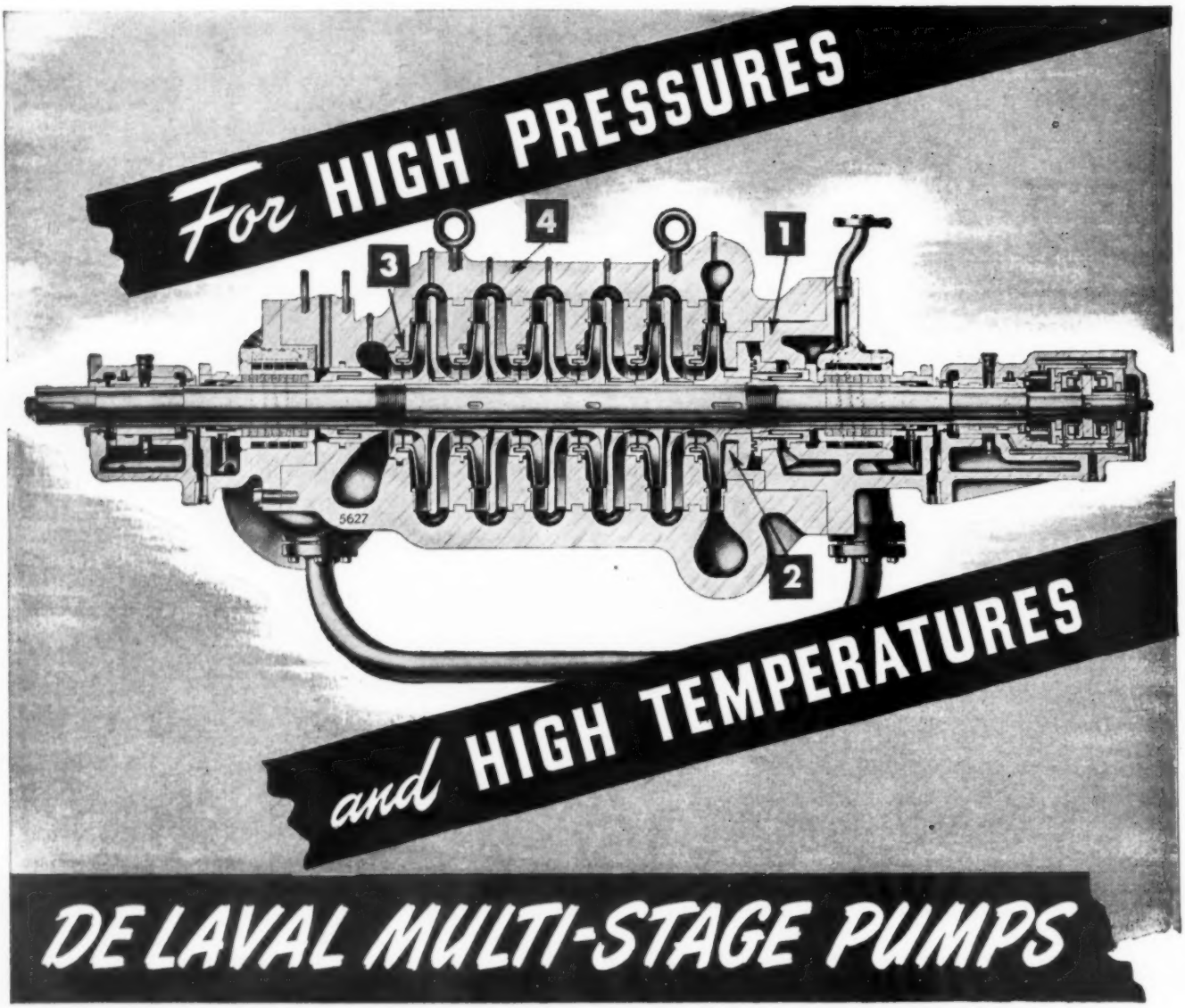
When the Sulloway Hosiery Mills depended upon hand firing methods it was extremely difficult to carry the peak loads, according to Chief Engineer Edmund J. Garneau. After installation of Iron Fireman Pneumatic Spreader stokers under the same boilers, the company was able to add three processing machines, increasing the load as much as 42% at peak periods. This was accomplished with but very slight increase in coal consumption. In addition to increased production and lowered fuel costs, Mr. Garneau states that elimination of supervision in the boiler room and Iron Fireman's overall dependable performance have been highly gratifying.

What about YOUR boiler room?

Are you sure your steam and labor costs are as low as they should be? Without cost or obligation you can have an accurate, impartial survey of your boiler room. Write to Iron Fireman Manufacturing Company, 3046 West 106th Street, Cleveland 11, Ohio. Plants at Portland, Oregon; Cleveland, Ohio; Toronto, Canada. Dealers throughout the United States and Canada.

IRON FIREMAN

THE IRON FIREMAN



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2 **AUTOMATIC HYDRAULIC BALANCING** leaves no unbalanced thrust to be taken up by thrust bearings or other metallic contacts subject to wear.

3 **LABYRINTH WEARING RINGS** minimize leakage from discharge to suction without requiring close mechanical clearances.

4 **CASINGS AND IMPELLERS** built of materials carefully selected to endure the particular service for which the pump is intended.

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JULY 1946

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A CROSS-INDEX OF SUBJECTS FOR THE MONTH

PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
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TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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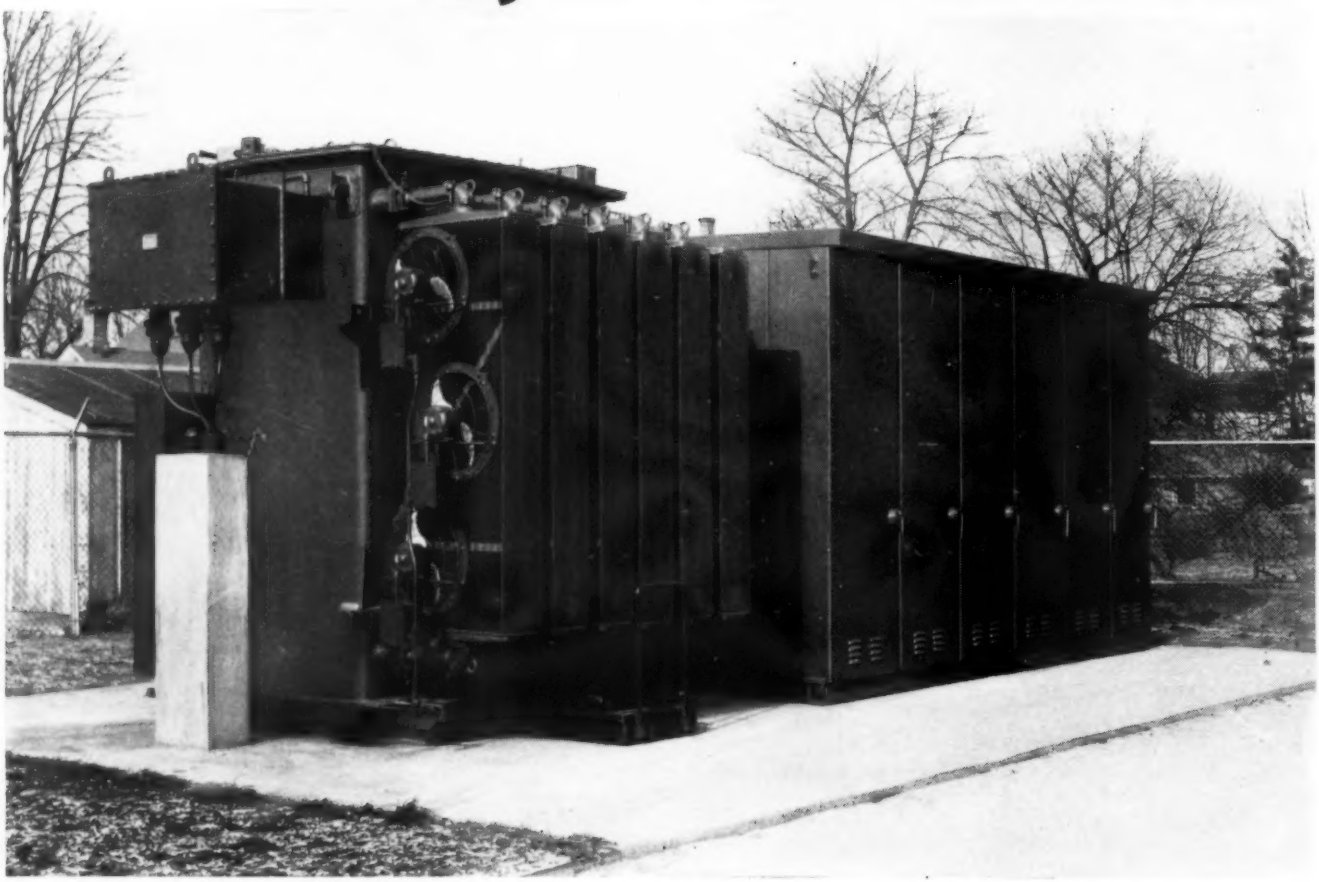
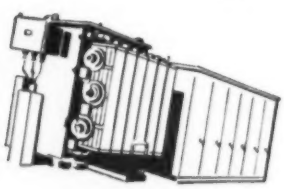
System Flexibility



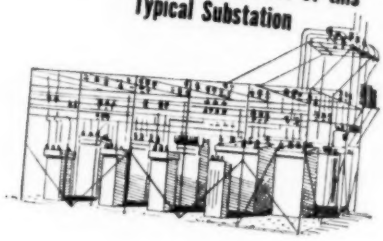
Westinghouse Unit Substations are "made up" of standard transformers and interchangeable "Unitized" switchgear allowing additional Feeder Units to be applied simply—greatly reducing special engineering and total time from order to installation.

WESTINGHOUSE UNIT SUBSTATIONS INCLUDE ALL THE COMPONENTS OF A CONVENTIONAL SUBSTATION

This Westinghouse Multi Feeder Unit Substation



Contains all the Elements of this Typical Substation



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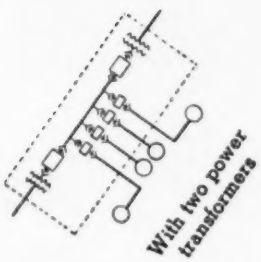
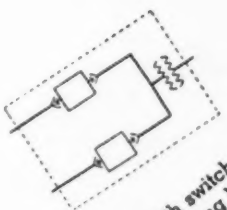
More and more power companies are installing Westinghouse Unit Substations in meeting existing load requirements and planning for load growth. By locating at center of load, unit capacities can be selected to keep the system investment "tailored" closely to existing needs. Flexibility is provided by the relatively simple addition of feeders to existing units or the increment installation of new units, for load growth or by the relocation of existing units as the load pattern changes.

Compactness giving more than twice the capacity in half the space—lowers real estate cost—also permits installation in areas or locations otherwise unavailable for substation use.

For further information, call your Westinghouse Office, or write for B-3238 to Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-97114

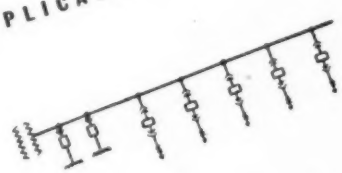


With two power transformers

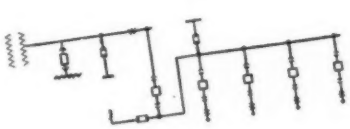


With switchgear for incoming h-v circuits

VERSATILE IN APPLICATION



For radial distribution



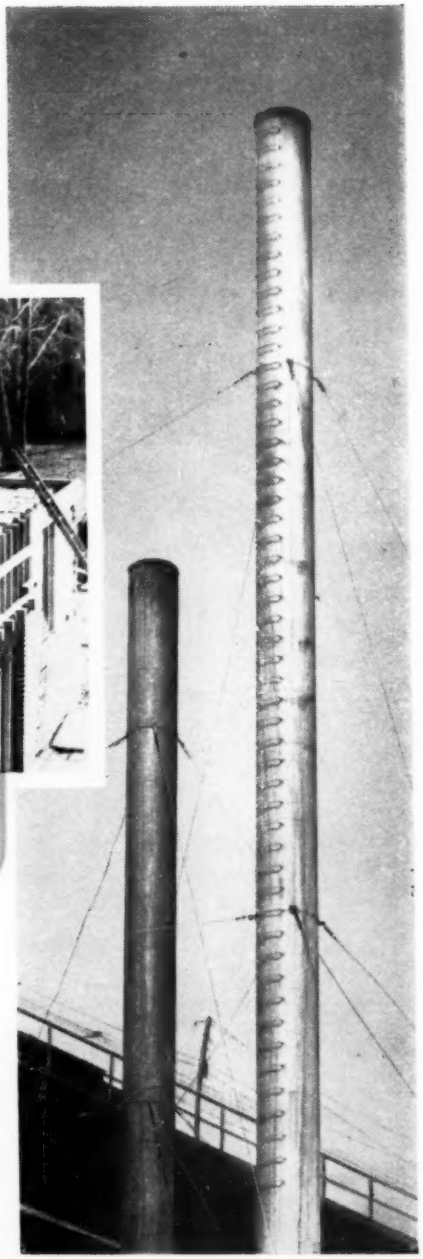
For primary network distribution

7 Reasons why Westinghouse Unit Substations are the answers in Distribution Planning

1. Increment Unit capacity — reduces system investment.
2. *Modern, unobtrusive appearance.*
3. *Compact,* twice the capacity in one-half the space.
4. *Minimum* installation time and cost.
5. *Improved service continuity.*
6. *Automatic Voltage Regulation.*
7. Safe operation—tamper-proof.

UNIT SUBSTATIONS

BYERS WROUGHT IRON serves at both ends of this Industrial Heating Job



The Gibsonburg Lime Products Company of Gibsonburg, Ohio, recently erected a 70-ft. stack to serve a new boiler, and installed radiant heating in a new plant office building. In both these services, corrosion is the major threat to long service life. In both, the same time-tried material was selected to combat corrosion—Byers Wrought Iron.

It is always interesting to know what evidence has influenced the choice of materials. In this case, it was the report of an elderly engineer friend, who told of wrought iron stacks that had served for periods up to 45 years, with no repairs or replacements. The choice of Byers Wrought Iron pipe for the radiant heating system followed accepted engineering practice. Of the thousands of successful radiant heating installations now operating, an overwhelming majority are of course wrought iron.

If you are considering a new stack, you will find it profitable to investigate the record of Byers Wrought Iron. Conditions vary so widely that it is unsound to generalize about probable life. But in any application where an unlined metal stack can be properly used, the weight of evidence indicates that wrought iron can be expected to serve longer. In the case of radiant heating, wrought iron not only offers corrosion resistance, but a combination of other qualities that recommend it: easy fabrication; a coefficient of expansion and contraction almost identical with that of concrete and plaster; and high heat emission.

If you would like a quick picture of some of the many places where Byers Wrought Iron is serving, ask for our bulletin, "101 Uses for Wrought Iron."

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Seattle, San Francisco.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

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TUBULAR AND HOT ROLLED PRODUCTS
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POWER

PHILIP W SWAIN, EDITOR • JULY 1946 • ESTABLISHED IN 1882

Is BIKINI Worth-While?

THIS PERSONAL NOTE to the readers of POWER is written before my departure for the atom bomb tests at Bikini Atoll, where I shall be the official press representative of all the McGraw-Hill technical and business publications. For the period of this unique "Operation Crossroads," conducted by Joint Army-Navy Task Force I, I shall also act as technical consultant to the Columbia Broadcasting System, available to check the technical content of broadcasts from the Pacific or to go on the air in person.

During my absence, which will extend into September, POWER'S editorial direction will be in the capable hands of Louis Rowley, managing editor.

One should not attempt to prejudge an experiment. However, I shall take this opportunity to tell how I feel now about "Operation Crossroads."

I agree one-hundred percent with those who hold that the atom bomb is the greatest threat to the human race in all history, and that there is not likely to be found any effective protection against it except through international control, first of atomic energy, and not much later, of all war potential. Yet I do not agree with those who call "Operation Crossroads" a mistake, a menacing display of force, a waste of time and money. Here, much briefed, are some typical arguments and my answers:

"The tests will add little to *basic* scientific knowledge." Right, but they will help show what kind of ships, how equipped and how disposed, can best avoid destruction by atomic bombs.

"The tests will cost hundreds of millions of dollars." Figuring the few ships destroyed at salvage value, the total cost will about equal that of one new battleship.

"The tests are a threat to other navies." Whose navy? Certainly not the British; and what other navy would require atomic weapons for us to defeat?

"Well, if the tests are designed chiefly to show how to *defend* our Navy against atomic bombs, what's the use? There is no protection." Certainly any ship close to an atomic explosion will sink, but if we are to build any more navy of any kind, we must learn at what distances various types of ships, boilers, turbines, instruments and armament will survive. Why build ships and equipment without knowing their suitability?

"Navies won't be able to protect our country in an atomic war because rockets will be able to attack us directly from overseas." This may come in time, but who would, therefore, suggest disbanding our Navy now? Certainly it is common sense to maintain every possible protection until we have absolute *proof* that it can no longer serve.

"An atom bomb falling on a city will kill more people and destroy more property than one falling on a ship, so atom bombs will not be used on ships." Since there will be plenty of bombs for all worth-while targets, why be so sure that an enemy won't think it worth-while to drop a million-dollar atom bomb on a hundred-million-dollar ship?

These are my thoughts about "Crossroads" at the moment of this writing. Further reflection and first-hand observation this summer may bring me new light on some of these points. If so, I won't hesitate to confess a change of mind. When it comes to atomic energy, being right is more important than being consistent.

PHILIP SWAIN, *Editor*

Three Stoker-Fired Boilers Replace Nine Hand-Fired Units in Three Plants

To supply steam for a large gas works nine hand-fired boilers burned high-grade coke which had a ready local market. Now, fired with coke breeze on traveling grate stokers, three modern boilers do the job with one unit as a spare. The low-grade fuel and improvement in combustion efficiency reduce steam costs

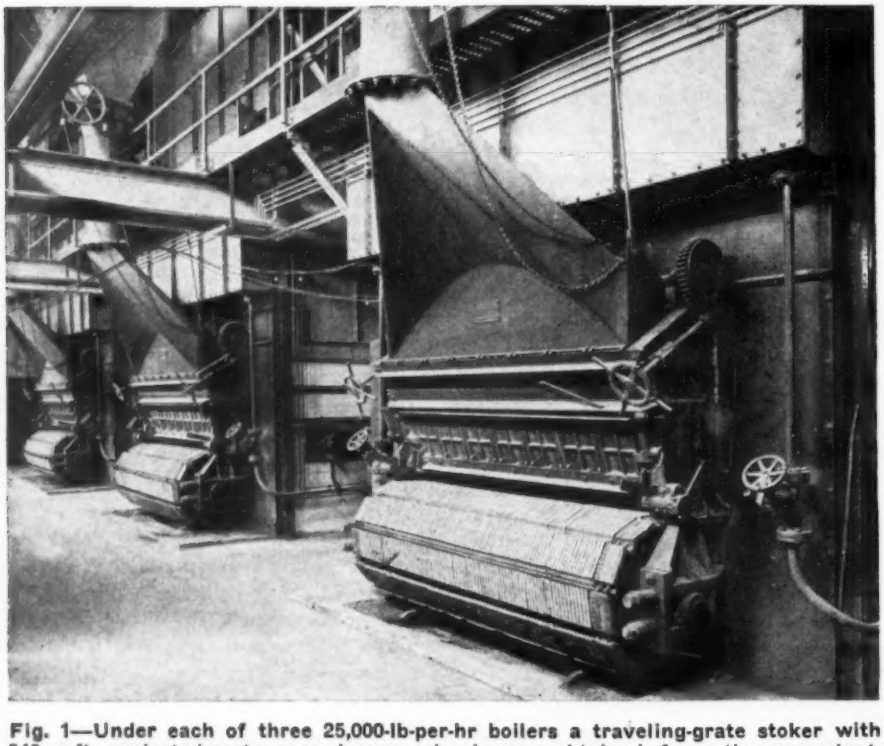


Fig. 1—Under each of three 25,000-lb-per-hr boilers a traveling-grate stoker with 240-sq-ft projected-grate area burns coke breeze obtained from the gas plant

► FOR NEARLY 100 YEARS the Consumers' Gas Co of Toronto has supplied gas to the city of Toronto, Ont. Starting in 1849 with an output of 5.8 million cu ft of gas the company's plants expanded to provide 100% reliable service until in 1945 output reached nearly 7.5 billion cu ft. Operations are centered in two plants, stations *A* and *B*, about two miles apart.

Station *B* is a comparatively new development whereas *A*, an old plant, has been modernized and expanded until it now covers three city blocks. Even though gas-producing equipment in the modernized station was efficient, steam boilers were old, inefficient and unsuited to economical operation. First the business depression and then the war prevented installing a new boiler plant until early in 1944 when it was decided that something had to be done. At that time the company's engineering staff started studies under the direction of Edward J Tucker, vice-president and general manager, W C Philpot, general superintendent and G F Knight, works engineer.

PLANT REQUIREMENTS

A gas works requires continuous 24-hr-per-day operation. Therefore 100% reliability is a prime consideration in every part of its design and operation. It also requires large quantities of steam in the gas process direct, for power generation, and for driving gas exhausters and compressors, air compressors and blowers, pumps and other equipment. Large quantities of heat in the waste gas from the gas-producing process and low-grade fuel in the form of screenings from coke operations (coke breeze) are a byproduct of coal-gas production.

Station *A* had four separate steam plants several hundred feet apart, all connected into a common header system. Each plant was an independent unit with its own operating crew. Three of the plants were hand-fired, the fourth operated on waste heat in the stack gas from the coal-gas producers.

One of the fuel-fired plants had three 3000-sq-ft Scotch marine boilers, 37 years old. As this plant had very little fuel-storage space, fuel (coke) was trucked from the coke shed in another part of the works. A second plant had four 3000-sq-ft Scotch marine boilers, from 31 to 41 years old, fired by coke and occasionally by gas coal. A belt conveyor delivered fuel to these boilers. A third plant had two watertube boilers about 30 years old, one with 1500 and the other 2500 sq ft of heating surface, fired with coke breeze and small-sized coke. The four waste-heat boilers on the coal-gas plant are comparatively modern, efficient and in good operating condition. Each has 3000 sq ft of steam-making surface.

Not only were the hand-fired boilers old and inefficient and their operating cost high, but they were not suited to burning the available low-grade fuel (coke breeze) for which there is little market. As a result, to produce the necessary steam, these boilers burned a considerable amount of high-grade coke made at the plant, for which there is a favorable local market.

ENGINEERING STUDIES

Engineering studies for a new boiler plant were based on scrapping the nine old hand-fired boilers and retaining the four waste-heat units, which produce steam at about one tenth the cost of that from the old boilers. Maximum hourly steam demands ranged from 46,000 to 56,000 lb per hr. Steam load is not likely to increase appreciably over the next five years because the present gas-making equipment is running at about maximum capacity. If the coal-gas plant is shut down and the water-gas capacity in-

creased, the steam load will change radically in a way that can not now be predicted. Therefore to meet current steam demands it was decided to install three boilers, each of a continuous steam-making capacity of 25,000 lb per hr. Thus, the maximum steam demand could be met with two boilers, one a spare. They were to be conservatively rated so two could take care of any unexpected hourly peaks.

FUEL SELECTION

Available for fuel were: (1) manufactured gas (2) coal-gas tar burned in liquid form (3) gas-coal screenings burned on stokers (4) pulverized coal (5) coke breeze. Even if it had been economical to burn manufactured gas under the new boilers a sufficient quantity was not available without extending the company's gas-manufacturing facilities.

There is a ready market for all coal tar produced in the gas-making process at prices that make it uneconomical to burn it as fuel for steam production. To burn it would require additional tar-storage capacity at the plant to balance varying tar production against varying steam demands. Normally sufficient tar would be available to produce all steam required.

However, if any of the producers were out of service for rebuilding there would be a tar deficiency because of the reduction in the amount produced and the increase in steam demand for added water-gas production. Under these conditions a second fuel would have to be provided to compensate for the tar deficiency.

Ruling against tar as a fuel under current conditions were: (1) a ready market at favorable prices (2) additional storage capacity required for it as fuel (3) need of a supplementary fuel. Many U. S. gas works burn tar under their boilers because of rigid requirements of tar users, and the low price offered for this byproduct. The engineers therefore decided to provide for the possibilities of this product as a boiler fuel in the new plant's design so a changeover could be made at low cost if it became economical to burn this fuel.

Screening the smaller sizes from the gas coal and burning them on stokers under the boilers would improve gas producers' operation and increase their output. Also, because the company was a large user of gas coal these screenings could be obtained at low cost. To make this fuel available would have required a coal-screening plant and storage for at least 500 tons of boiler fuel to carry over during periods when part of the coal-gas plant or equipment is down for repairs.

After a detailed study of costs at the mines and of freight rates it was decided that the trends were upward, making it more economical to use coal as received at the plant for gas making. Burning raw coal for steam generation wastes many of its valuable byproducts, and this is against the policy advocated for many years by the gas industry.

Burning coal screenings pulverized was also ruled against for the reasons already given for stokers, and for other objections.

Among the many advantages of burning the low-cost byproduct, coke breeze, on traveling grates are: (1) This fuel, which has a limited market, is available in sufficient quantities as long as the coal-gas plant operates. (2) It is becoming increasingly difficult to dispose of and has to be trucked to Station *B* for burning under boilers. (3) It would replace high-priced coal and saleable coke.

Coke screenings, however, is one of the most difficult fuels to burn under boilers. To handle it successfully, furnace and

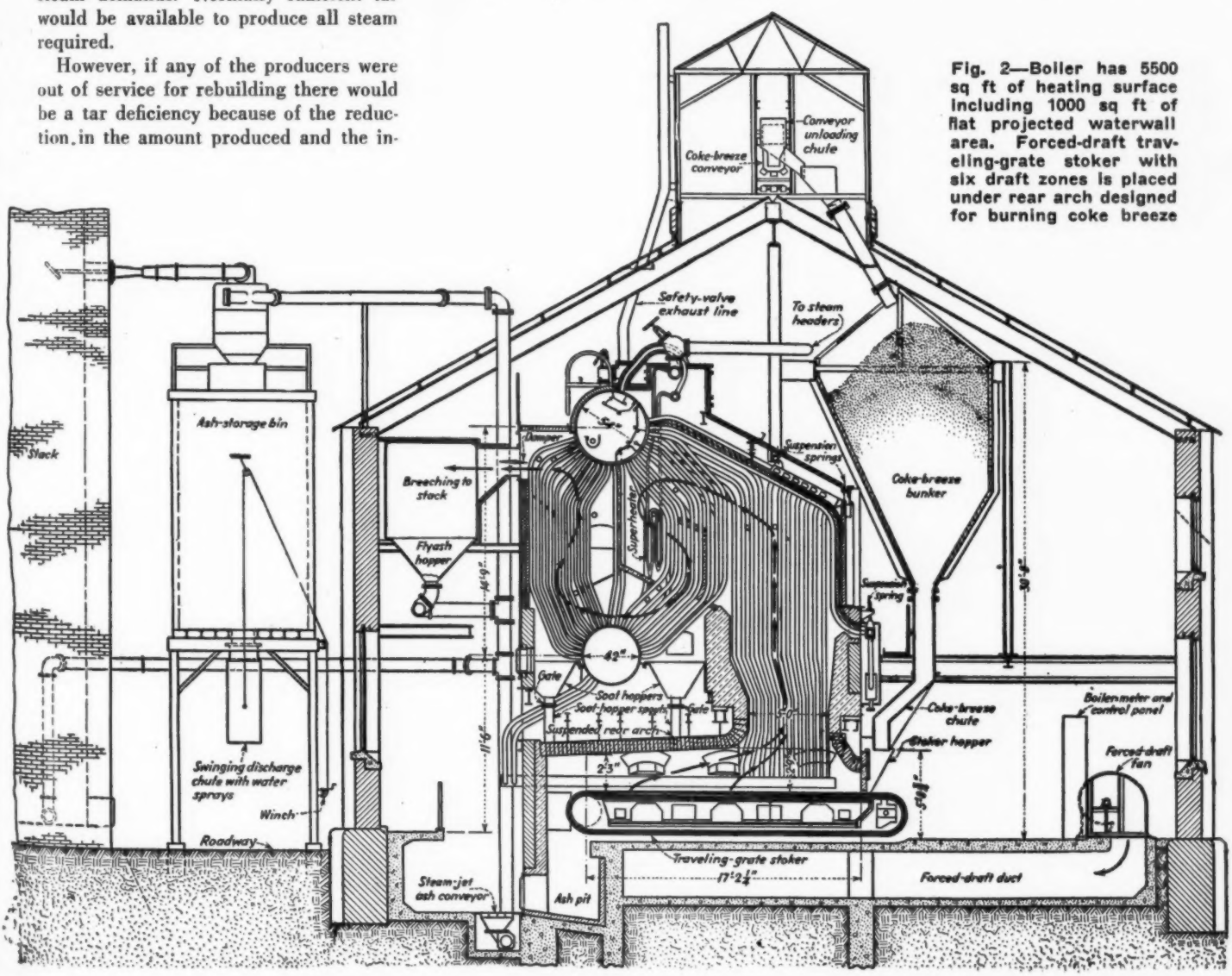
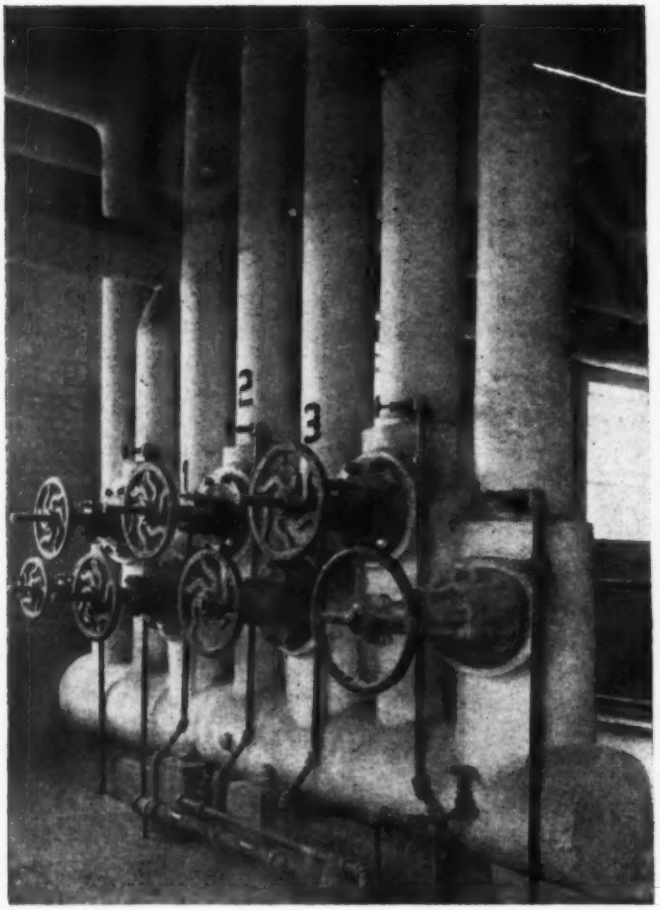


Fig. 2—Boiler has 5500 sq ft of heating surface including 1000 sq ft of flat projected waterwall area. Forced-draft traveling-grate stoker with six draft zones is placed under rear arch designed for burning coke breeze



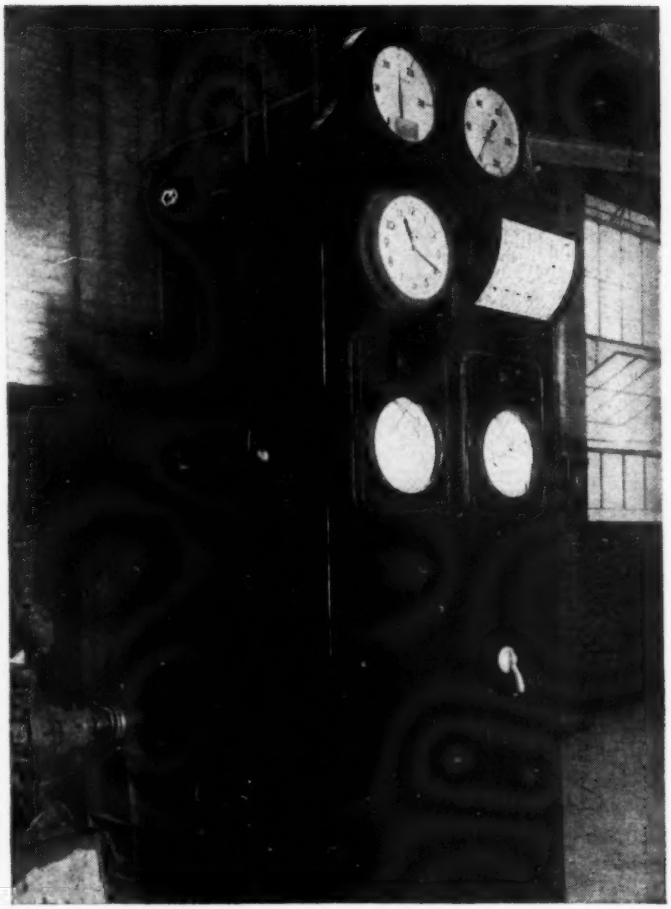


Fig. 3—One of the duplicate steam headers. Fig. 4—Steam-turbine and motor-driven forced-draft fan for one boiler back of meter panel. Draft controlled by stoker-zone dampers to increase stoker draft progressively, front to rear

stoker must be of correct design and size; even then the fires need close attention.

Because sufficient quantities of this fuel would be available at practically all times for steam production, and its use would result in operating-cost reductions the engineers decided to burn it on traveling-grate stokers. The final decision was confirmed by visits to several plants burning coke breeze successfully on traveling-grate stokers and by consultation with engineers of boiler and stoker manufacturers.

Out of these studies developed certain requirements pertinent to successful use of this fuel. In the order of their importance these are:

1. Moisture content must not be more than 18% and must be held fairly constant.

2. Fuel-range sizes had to be small and uniformly distributed. Best results were being obtained with sizes below ½ in.

3. A large furnace volume is required with 14-ft minimum height from grate to the nearest cold tube. An increase above 14-ft furnace height is advantageous to avoid troubles from blockage by unburned carbon being carried into boiler passes.

4. Large stoker-grate area is necessary to keep combustion rate low and fuel carryover into boiler passes at a minimum. Combustion rate should not exceed 25 lb of fuel per square foot of grate area per hour.

5. Ample provisions should be made for removal of fuel carryover into boiler passes, and the latter design must be made as simple and straight as possible.

NEW BOILER PLANT

Dominion Bridge Co. general contractor, was awarded the contract for the new plant and the three new boilers. These were installed in an existing vacant building adjacent to the 160-ft brick stack serving one of the old boiler plants to be scrapped. This stack combined with forced draft has sufficient capacity for three new units. If boiler ratings are increased beyond 150% or a fourth boiler is installed, increased draft capacity required will be obtained by addition of an induced-draft fan. Breeching design makes provision for this.

In the plant's design the engineers placed particular emphasis on features that would insure simple, reliable and efficient operation when burning coke breeze. Normal operation requires two boilers steaming at about 145% rated capacity. If one boiler has to be taken out of service quickly the other can carry a large part of the load until the reserve unit starts steaming.

The boilers are 2-drum bent-tube design, Fig. 2, with 5500 sq ft of heating surface including 1000 sq ft of flat projected waterwall area. They are designed for 160 psi but operate at 130, the old steam pressure, and sufficient superheat to insure dry steam to all parts of the extensive distribution system. This worked out to be a total steam temperature of 455 F. Oversized steam drums, 54-in. diameter, provide extra water-storage space in the boilers to increase operating reliability should boiler feed be interrupted temporarily.

Steam drums are suspended from overhead, but bottom ones move freely to compensate for expansion and contraction of boiler tubes. Bottom waterwall headers are in line with stoker-grate surface and serve both as feeders to sidewall tubes and as clinker chills. Coil springs support front-wall and sidewall tube headers, permitting free vertical movement to relieve expansion and contraction stresses. Feeder tubes from bot-

tom drum to front header are inside the boiler casing.

Firing is by a forced-draft traveling-grate stoker under long suspended-rear-arch furnace especially designed for coke breeze. The stoker is divided for forced-draft control into six zones. Draft is progressively increased from front to rear of stokers for proper burning of the breeze. The suspended arch slopes upward from rear to front end of stokers. Above the latter, gas passes up through a narrow throat to create turbulence and improve combustion. Carryover collects at the bottom of the boilers' passes in hoppers that are opened periodically to return unburned fuel to the stokers.

COKE-AND-ASH HANDLING

A belt conveyor carries coke breeze from the coke-classifying plant to above the boilerhouse and there discharges it to a horizontal conveyor. The latter automatically discharges the breeze into chutes that lead to inverted-pyramid-bottom vitrified-tile-lined totally inclosed steel bunkers, one in front of each boiler. Conical chutes, specially designed to prevent segregation of fine and coarse particles, feed the breeze to stoker hoppers.

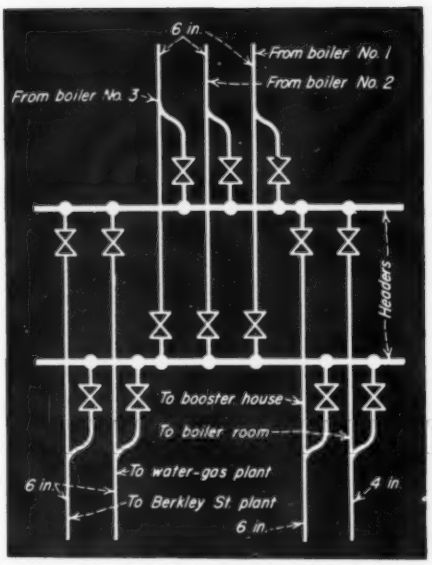


Fig. 5—To increase the plant's reliability boilers and steam-distribution lines connect to duplicate steam headers that make it possible to get steam from the boilers to the distribution lines during practically any emergency

Ashes from the stokers drop into hoppers from which they are raked to a steam-jet conveying system that discharges them to an elevated vitrified-tile tank for removal by truck. The three boilers connect to the stack by a common breeching. Flue-gas flyash drops in hoppers in the breeching's bottom where it is removed by the ash-handling system during normal boiler operation.

Stokers are driven by steam engines, which are considered more reliable than electric motors, particularly where electric power may be interrupted unexpectedly. Each boiler has its own forced-draft fan, making its operation independent of the others, and thus adding to the plant's reliability. A motor and a turbine drive each fan to insure its operation at all times.

Steam connections from each boiler run directly to duplicate steam headers. Outgoing steam lines also connect to both headers, Fig. 3 and 5. Valves in the header connections make it possible to get steam from the boilers to the distribution lines during practically any emergency. Feedwater is supplied by two feed pumps, one steam-turbine- and the other motor-driven. To insure getting water into the boilers under all conditions these pumps discharge into a loop header, either leg of which connects to the boilers.

Coke breeze is weighed automatically

PRINCIPAL STEAM AND ELECTRICAL EQUIPMENT

Boiler Plant of Consumers' Gas Co of Toronto

STEAM-GENERATING EQUIPMENT:

Boilers, waterwalls and superheaters.....Dominion Bridge Co
Boilers, 3: bent-tube, 2-drum, each 5500 sq ft of heating surface including 1000 sq ft of flat projected area of waterwalls; rated 25,000-lb-per-hr continuous-steaming capacity, 160-psi design pressure 130-psi working pressure at superheater outlet; 1100 cu ft furnace volume; 33,000 Btu maximum heat release per cu ft per hr; integral superheater, continuous tube, 455-F total steam temperature
Boiler refractories.....North American Refractory Co; General Refractories Co
Boiler settings built by.....Taylor Engineering Co
Heat insulation.....Taylor Engineering Co
Soot blowers, automatic compressed air.Diamond Power Specialty Corp
Boiler casings, ducts and breechings.....Dominion Bridge Co

COMBUSTION EQUIPMENT:

Stokers, Coxe, 3.....Combustion Engineering Co
Traveling grate, 16 ft, 4 in. long by 7 ft, 8 in. wide, 126-sq ft projected-grate area, 26.2 lb of fuel per hr per sq ft of grate area, at normal boiler rating
Stoker engines.....Troy Engine & Machine Co
Stoker gears, double-reduction worm.....Combustion Engrg Co
Furnace-pressure regulators.....A W Cash Co
Nonsegregating fuel distributors.....Stock Engineering Co
Forced-draft fans.....Sheldons, Ltd
One per boiler, turbine and motor driven, 35,000 lb per hr at 9-in. wg and 85 F
Forced-draft-fan turbines, 3.....Coppus Engineering Corp
15 hp, 130 psi, 430-F steam, 1460 rpm
Forced-draft-fan motors, 3.....Canadian General Electric Co
15 hp, 550 v, 1460 rpm, squirrel cage
Automatic clutches between motors and fans
Automatic Clutch Corp of Canada
Motor starters, full voltage.....CanadianGeneral Electric Co
Safety switches.....Bull Dog Electric Products Co; Square D Co

COKE AND ASH-HANDLING EQUIPMENT:

Conveyor belts, 16 in. wide, 10 tons per hr.....Link-Belt Co
Conveyor idlers.....Link-Belt Co
Conveyor motor, 1.....Bepco Canada, Ltd
5 hp, 550 v, 1450 rpm, totally inclosed, squirrel cage
Reduction gear.....De Laval Steam Turbine Co
Automatic scale.....Canadian Fairbanks-Morse Co

Dominion Bridge Co, General Contractor

Automatic Clutch.....Automatic Clutch Corp of Canada
Conveyor-motor starter, full voltage.....Cutler-Hammer, Inc
Coke bunkers.....Dominion Bridge Co
Steel, tile lined, 20-ton capacity
Ash-disposal system, steam jet.....United Conveyors Co of Canada
Vitrified-tile ash-storage tank.....United Conveyors Co of Canada
750-cu-ft storage capacity

VALVES; PIPING AND TRAPS:

Safety valves.....Manning, Maxwell & Moore, Inc
Blowdown valves.....Yarnall-Waring Co
Nonreturn valves.....Jenkins Bros, Ltd
High-pressure valves.....Sandilands Valve Mfg Co; Jenkins Bros, Ltd
Feedwater valves.....Jenkins Bros, Ltd
Piping contractor.....George C Abbott, Ltd
Piping insulation.....George C Abbott, Ltd
Traps and strainers.....Sarco Canada, Ltd

FEEDWATER SYSTEM:

Feedwater-conditioning consulting engrs.....Betz Laboratories, Ltd
Feedwater treatment and heating equipment.....Permutit Co
For hot-lime-soda process, 60,000 lb per hr
Phosphate after-treatment pumps.....Milton Roy Pumps Co
Phosphate-pump motor starters.....Canadian General Electric Co
Phosphate-pump timers.....Automatic Temperature Control Co
Boiler-water sampling coolers.....Permutit Co
Feedwater control.....Bailey Meter Co
Excess-pressure regulator.....Fisher Governor Co
Water columns.....Reliance Gauge Column Co
Feed pumps, 2.....Canadian Ingersoll-Rand Co
One turbine- and 1 motor-driven, 147 gpm, 530-ft head
Feed-pump turbine, 40 hp, 3450 rpm.....Coppus Engineering Corp
Feed-pump motor.....Canadian General Electric Co
40 hp, 1450 rpm, 550 v, squirrel cage
Motor control, full voltage.....Canadian General Electric Co
Feed-pump gear speed increaser.....Dominion Engineering Co

METERS:

Boiler-meters and control boards.....Bailey Meter Co
Boiler meters, steam-flow meters, flue-gas temperature recorders, steam-pressure and temperature recorders and 8-point draft gages
Bailey Meter Co
Pressure gages.....Mulcott Co, Ltd

on the conveyor that delivers it to the bunkers in front of the boilers. Each boiler has a steam-flow and a steam-flow air-flow meter, also a flue-gas-temperature recorder, steam-pressure gage and 8-point draft gage. The latter indicates draft in the boiler uptake, furnace and six stoker zones. Main control panel also records the outgoing steam pressure and temperature and also the pressure in the feedwater lines. With this equipment to guide them the operators maintain practical boiler- and furnace-test performance continuously. Changes from this condition are readily detected and corrected.

In service for several months, the boilers supply all steam demands by burning coke breeze, no gas coal or marketable coke being required. Plant operations have been greatly simplified and fuel burned under the boilers reduced about 40% below that required in the old plants. Over-all saving resulting from the new boilers will pay their cost in a reasonably short time.

POWER *expresses appreciation to Edward J Tucker, vice-president and general manager, Consumers Gas Co of Toronto, for permission to write this story, and to G F Knight, works engineer, for assistance in writing it and for making available the results of his extensive engineering studies of burning coke breeze on traveling-grate stokers.*

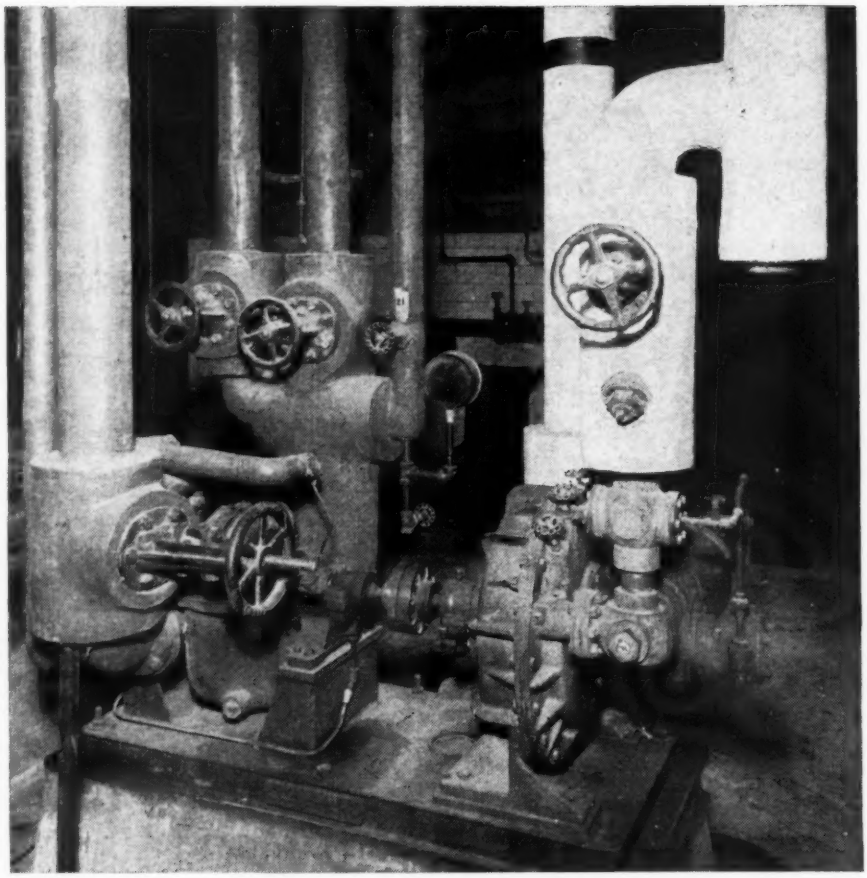


Fig. 6—To insure getting water into the boilers under all conditions the two feed pumps discharge into a loop header, either leg of which connects to the boilers

Accuracy in Water Testing

▶ A RECENT NUMBER of "The Betz Indicator," published by W H & L D Betz, Philadelphia, carried the following question from a reader:

"In the answer appearing to the question in the November 1945, issue of The Betz Indicator, you state that the hardness test is limited to an accuracy of 2 ppm, the chloride test to a possible error of 1 ppm, and the sulfate test to as much as 10 ppm. With such errors existing, how much dependency can be placed in a water analysis?"

Following are the main points of the answer:

"Let us start off in answering your question to recall for you that in dealing with various constituents reported in a water analysis, we are dealing with extremely small amounts. Never lose sight of the fact that one part per million, the usual nomenclature in reporting a water analysis, is one ten-thousandth of one percent. Therefore, when we are speaking of an accuracy limitation in the hardness test of 2 ppm, we are speaking of a limitation of accuracy of 2/10,000 of 1%. This means that in conducting the soap test for a hardness determination the operator must determine the point of permanent lather to within 0.1 ml or approximately two drops of the soap solution. This is not an easy point to determine for a relatively inexperienced operator.

CHLORIDE DETERMINATION

"In the case of the chloride determination the limitation of error of 1 ppm means a titrating error in determining the end point of no more than 1 drop of the silver-nitrate solution. Again a point not too easy to determine for the average operator who is running these tests only a few times daily.

"In speaking of the possible error in the sulfate determination, we said, 'Sulfate, dependent on the method of analysis, may show an error of from 1 to 10 ppm.' Please note we said 'dependent on the method of analysis.' There are several different control methods of analysis of sulfates. Some methods are based on the obscuring of a light by precipitated barium sulfate. If this principle is applied using a turbidimeter or photometer, it can be very accurate, but if the eye alone is used to observe the obscurity of the light it can be very inaccurate. The method we prefer for routine control purposes is the THQ method employing tetrahydroxyquinone as an internal indicator. It is not only rapid but is quite accurate. The limitations of error of any sulfate determination will be dependent on the method used.

"All of the deviations from absolute accuracy mentioned above are based on the use of a 50 ml sample for analysis. Please understand, greater accuracies can be procured by changing the size of the sample and the strength of the titrating solutions, except in the case of the hardness determination. Furthermore, such

(*Continued on page* 144)

New Developments Spotlight Progress In Gas-Diesels and Supercharging

Dual-fuel engines, application of diesels to better operating schedules of steam plants, new system of supercharging and internal cooling for high output, electrical and chain drives for speed reduction, new railroad units reported to engineers

▶ A SUMMARY OF RECENT DEVELOPMENTS in the gas-diesel engine, description of a new method of supercharging 4-cycle diesels and discussion of speed-reducing methods highlighted the 18th National Oil and Gas Power Conference, held June 12-15 at the Hotel Schroeder, Milwaukee. More than 500 engineers of the diesel and gas-engine industry attended the sessions.

New Gas-Diesel. In a symposium on gas-diesels, Ralph Miller, Nordberg Mfg Co, reviewed briefly the early history of efforts to burn gas at diesel pressures and efficiencies. (See POWER, May 1945, pp 64-70 for a comprehensive explanation of the working cycle of such engines and their engineering features.) He then described a new 4-cycle supercharged gas-diesel built by his company. As shown in Fig. 1, gas is admitted directly to the cylinder; a cam-operated gas-admission valve is timed to open after scavenging is completed and to close with the air-inlet valve. A gas-supply valve may be adjusted to give any desired proportions of gas and diesel fuel; closing of this valve, or failure of the gas supply, automatically switches the engine to operate on oil, without interruption. Control is designed so that the engine always uses all gas available and diesel fuel makes up the deficiency. Pilot fuel may be supplied by separate pumps through nozzles designed for small fuel rates if it is desired to operate with a low percentage of pilot fuel.

Engine Performance. In discussing performance of this engine, Miller said that tests run with 90-F manifold temperature—the supercharging system is intercooled—showed a thermal efficiency of 40%, based on high heat value of gas and pilot fuel. This figure was reached at 140 bmep. He pointed out that low efficiency at light loads seems characteristic of the low-pressure gas-diesel, and that the cause may be that the mixture is too lean to burn efficiently. The fact that exhaust temperature at 70 bmep is higher when operating on gas than on oil indicates that inefficient combustion and afterburning is the cause of low efficiency rather than loss of unburned fuel. Miller expressed belief in the possibility of reducing fuel consumption at light loads by controlling the turbocharger so as to operate at lower manifold pressure, producing an air-fuel ratio more nearly equal to that realized at the high loads.

Another New Design. On the same program, C E Fox, Chicago Pneumatic Tool Co, outlined the path by which his organization approached development of an engine that would compress a gas-air mixture to diesel pressure levels, with ignition by pilot oil. In the design of the engine, simplicity was a paramount consideration, and for this reason the regular injection system is used for pilot oil. The control system is such that during the first half of governor travel, oil rate is held to that for pilot ignition while the gas-control valve moves from closed to wide open. A spring-loaded control-rack

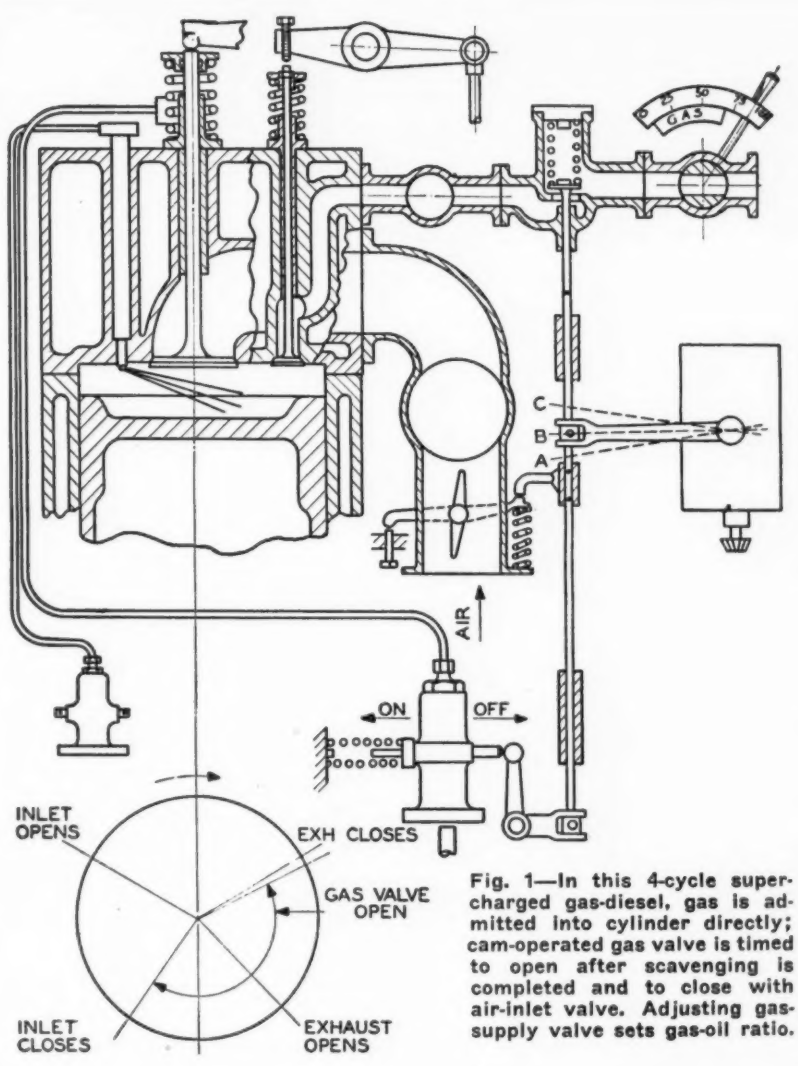


Fig. 1—In this 4-cycle supercharged gas-diesel, gas is admitted into cylinder directly; cam-operated gas valve is timed to open after scavenging is completed and to close with air-inlet valve. Adjusting gas-supply valve sets gas-oil ratio.

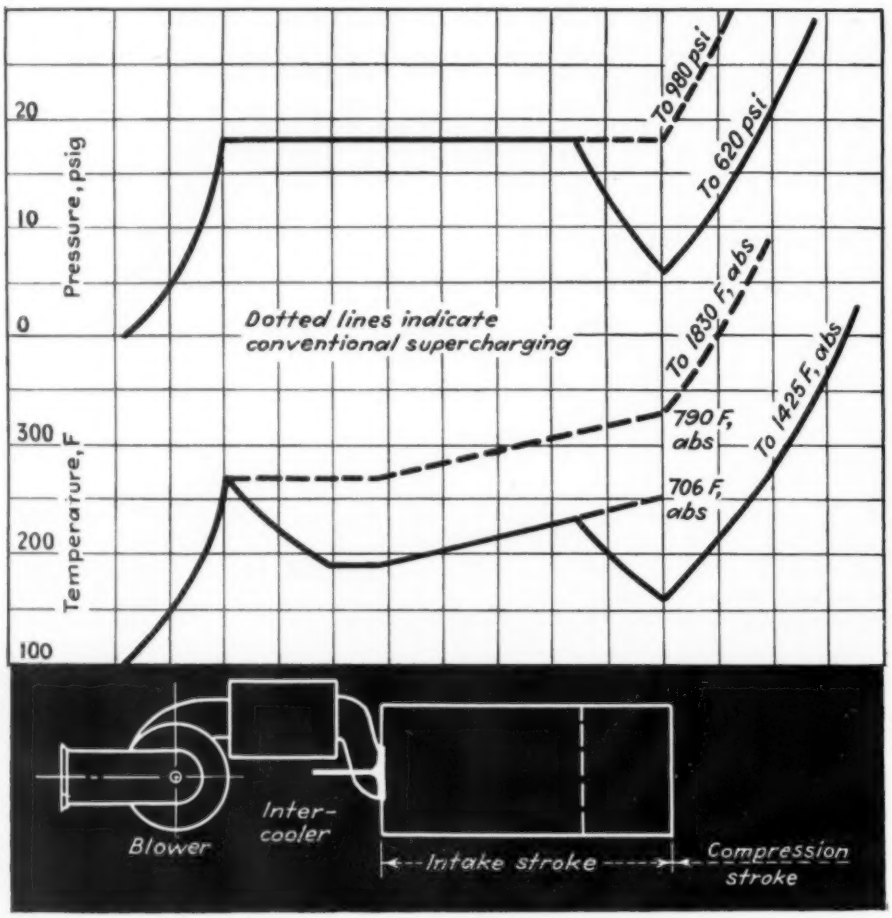


Fig. 2—On principle that temperature reduction before compression is more effective in increasing output than boosting pressure, supercharging cycle starts with relatively high pressure followed by intercooling and by expansion to the desired supercharging pressure, with resulting cooling. Net effect is substantial increase in air charge, hence greater output. Chart shows pressures, temperatures

stop permits adjusting pilot-fuel rate, and a gas-pressure regulator is set so that at about 110% full load, any additional load will be carried by fuel oil. If gas pressure drops below that required to carry full load on gas plus pilot oil, the governor goes into the second half of its travel and additional fuel oil supplements the gas. A hand-operated valve to throttle the gas permits operation on any proportion of gas and fuel oil desired.

Gas-Diesel Experience. Discussing experience with this design, Cox stated that a fuel consumption of 7500 Btu per bhphr was obtained with 10% pilot fuel at full load. He reviewed experimental work on the injection system which led to the conclusion that use of special spray tips or an auxiliary injection system to permit reduction of pilot-oil quantity below 10% was not justified. Efforts to improve low-load fuel consumption by throttling the air were not encouraging, possibly because pumping losses tend to offset gains from the smaller amount of heat lost through excess air.

Two-Cycle Gas-Diesel. Reviewing development in the gas-diesel field by his company, Ralph Boyer, Cooper-Bessemer Corp, stated that this principle has been successfully applied to 4-cycle atmospheric, 4-cycle supercharged and 2-cycle engines (see POWER, Jan 1946, pp 71-75). Performance curves for these engines were presented. Boyer pointed out that the 2-cycle engine presents a different problem from the 4-cycle, requiring that gas be injected, at 25 psi, after ports are closed. Since in modern 2-cycle gas engines gas is injected after port closing, it was only necessary to adapt the design for both gas and fuel injection on the same cylinder. It is not yet possible to attain normal gas-engine rating with this combination, without increasing percentage of fuel oil, but it is anticipated that this percentage will eventually be as low as on a 4-cycle engine.

Concluding the symposium on dual-fuel engines, J C Barnaby, Worthington Pump & Machinery Corp, described developments made by his company.

Diesels in Steam Plants. At another session, Prof R B Rice, University of North Carolina, presented a report on progress in internal-combustion engines during the past ten years and A C Kirkwood, Burns & McDonnell Engineering Co, discussed the application of diesels in steam stations. He pointed out that operators and engineers have long studied means of meeting efficiently the inevitable load variations on central stations, and that there is good reason for belief that diesel-engine generators can be used successfully to improve steam-plant performance.

Stressing the need for detailed analysis of each case, Kirkwood presented data from such a study of a system involving two 5000-kw and two 10,000-kw turbine-generators. Addition of a 3000-kw diesel-generator to this system would improve the load factor of each turbine-generator and produce an annual saving of $1300 in fuel cost. While this saving is small, important gains result from better operating schedules and the addition of the diesel defers by two years installation of additional turbine-generators. It is interesting to note, Kirkwood said, that in this case, and many others, the diesel is not a peak-load unit but, instead, may be operated several hours both morning and evening to change operating schedules of turbine-generators to obtain vastly improved load factors of individual units.

New Supercharging System. Presenting an analysis of a new system of supercharging, Ralph Miller, Nordberg Mfg Co, said that theoretical analysis, verified by engine tests, shows that reducing temperature of the charge before compression is far more effective in increasing engine output than raising pressure. Intercooling of supercharged engines is a step in this direction but it is limited by the need for cold water to reach desired low temperatures.

In the dual-pressure supercharging cycle, internal cooling is produced by expansion of the charge from a high pressure to a lower pressure and temperature. The diagram of Fig. 2 shows the pressure and temperature path of the air up to the beginning of the compression stroke. For comparison, conventional supercharging is shown by dotted lines. Expansion cooling accomplishes lower initial compression temperatures with the same manifold temperatures.

Advantages of New System. Summarizing, Miller divided dual-pressure supercharging into three groups, according to pressure and temperature conditions, and cited the bmep obtainable in percent of nonsupercharged rating: (1) without intercooling between blower and inlet manifold and combustion pressures limited to those in a nonsupercharged engine, 140% of nonsupercharged rating (2) with inter-

cooling to give minimum permissible initial compression temperature and combustion pressures limited to those in a nonsupercharged engine, 175% (3) with intercooling to give minimum permissible initial compression temperature and *ratio* of combustion to compression pressure same as in a nonsupercharged engine, 200%. By selecting high manifold pressures and large expansion ratios minimum permissible compression temperature for operation under (2) and (3) may be obtained with manifold air temperature as high as 200 F, which permits using engine cooling water in series through the air intercooler. With the dual-pressure cycle, the scavenging pressure is higher than the supercharging pressure so that exhaust from a multiple-cylinder engine may be carried to the turbocharger in a single pipe without loss of scavenging efficiency.

Bowes Drive. At another session, B C Seaman, Elliott Co, discussed the design and performance of the Bowes drive, a fully electrical speed-reducing drive, which can also be built for reversing service. (For cross-section and description see POWER, Feb 1946, p 85) The drive consists of three concentric members, one on the engine shaft, one on the driven shaft and one stationary. There is no mechanical connection between engine and driven shafts. The drive may be considered as two separate units, a synchronous generator and a synchronous motor. Speed ratio is designed into the drive by proper selection of the number of poles in the generator and motor parts of the unit.

Trials of such a drive on a Maritime Commission C1-MA-V6 vessel showed a drive efficiency of 97% excluding excitation and 94.7% including excitation. The large difference in these values results from provision of sufficient over-excitation to provide stability of operation and simplify control. A noticeable improvement in over-all vibration of the ship compared to direct drive was noted. Stating the advantages of the Bowes drive, Seaman said that weight and space are saved, high electrical efficiency is obtained, better fuel economy results, power is available for auxiliaries, and when the driven shaft is not required to operate, large amounts of power are available for other service, such as cargo handling on a ship. If an emergency causes failure of the drive, the rotating members can be bolted together and operated at reduced speed. The fact that no large amounts of electrical power are switched under load simplifies control. At present, a 6 to 1 speed ratio is the practical limit.

Chain Drives. On the same program, N C Bremer, Morse Chain Co, told how transmission chain, long used successfully in industry, was applied during the war to marine drives. He pointed out that the primary function of chain drives in diesel-propelled vessels should be considered that of compounding or transferring power from two or more engines to a single propeller shaft and that while chain drives are efficient speed reducers they will not commonly be adapted to the function of speed and torque change in a single-screw vessel, as in this case a gear drive would be indicated because of its inherent compactness. Design possibilities of multiple-engine plants may often be enhanced by combining reduction gears with chain drives.

Discussing power-capacity ranges of chain drives, Bremer presented a table of ratings, which indicated that up to nearly 2000-hp per engine may be handled by a single transmission provided that input speed is fairly low (250-460 rpm). Such drives have sharply defined upper limits of rotative speed for any given pitch. While ratios as high as 10 to 1 may be used in industrial drives, the outside limit for marine service should be about 5 to 1, Bremer said. Chain drives for marine service are slightly more than 99% efficient at full load. They are not critical as regards oil viscosity but a separate sump strainer, and pump should be provided for the drive, and spray pipes should be placed to distribute oil to all parts of the chain. Oil cooling is not always necessary; when chain speed is less than 2500 fpm, oil temperatures seldom exceed 130 F.

Railroad Applications. In a symposium on railroad diesel engines, J H Davids, Fairbanks, Morse & Co, described design and construction features of that company's opposed-piston engine; Hans Bohuslav, Sterling Engine Co, discussed railroad applications of his company's Viking diesel; Ralph Boyer, Cooper-Bessemer Corp, outlined characteristics of two engines built for railway service, and Ralph Miller, Nordberg Mfg Co, dealt with the question of whether cylinder diameters for high-power diesel locomotives should be large or small.

Combustion Temperatures. In a further report on research into measurement of diesel combustion temperatures, O A Uyehara, P S Myers, K M Watson and L A Wilson, all of the University of Wisconsin, presented flame-temperature data obtained with the electro-optical pyrometer developed at the University, and performance curves showing the influence of operating variables. They used unique contour graphs to show combustion characteristics in an easily visualized form.

Gas Turbines. A series of six papers dealing with gas-turbine developments was presented. These also appear on the program for the semiannual meeting of ASME and will be reviewed in the report of that meeting to be published in August POWER.

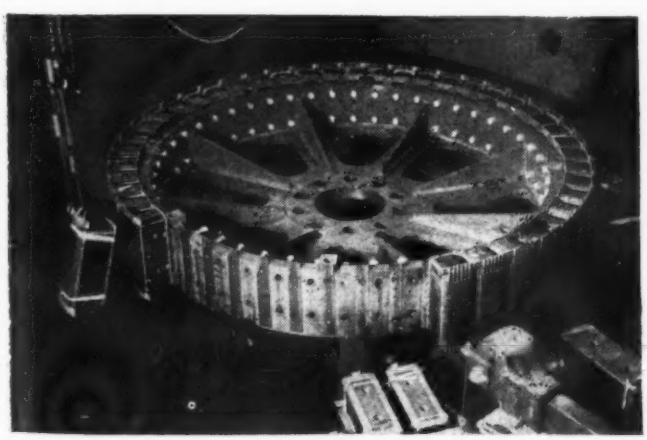


Fig. 3—Construction of inner member of Bowes drive follows that of alternating-current-generator field. Complete drive consists of inner member rotating with engine shaft, intermediate member on driven shaft, fixed outer member.

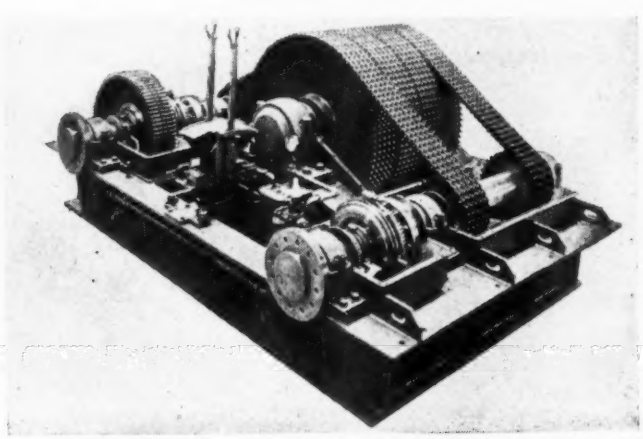
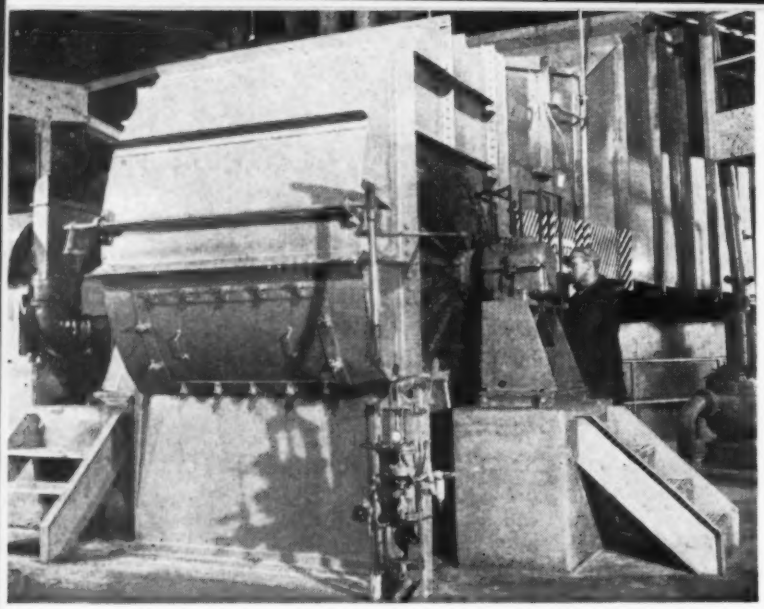
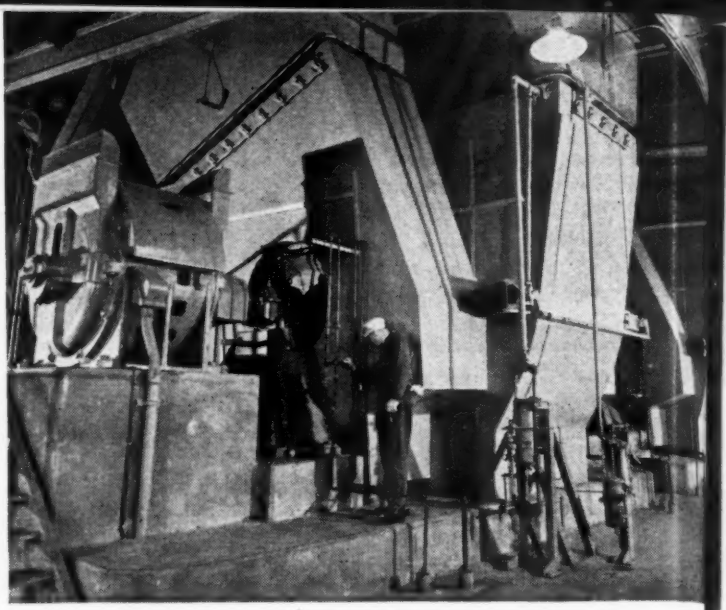


Fig. 4—Marine chain drive for two engines, 3-to-1 reduction, with disconnect clutches, emergency fire-pump drive



One of two forced-draft fans driven by single-speed motors; 132,000-cfm maximum capacity at 135 F, vane controlled



Two induced-draft fans with vane control, each driven by a single-speed motor; 230,000-cfm maximum capacity at 425 F

West Penn Power Adds New Unit At Springdale Station: 2

Concluding article on high-pressure installation that raises capacity of the mine-mouth plant to 319,000 kw net. First operated in December 1945, unit is essentially a separate station with no main steam connections to existing equipment

By G D BURLEIGH, *Engineer, Power Department, West Penn Power Co*

Station Performance. The station and equipment efficiency meets expectations, comparing favorably with that of other modern installations. Preliminary tests indicate a station net heat rate of 10,850 Btu per kwhr and a net coal rate of 0.86 lb per kwhr. Combined over-all efficiency of boiler, economizer and air preheater approximates 90%. These are for full-load conditions.

Steam Header. A 12-in. seamless chrome-molybdenum pipe with welded joints and fittings passes the high-pressure steam from boiler to turbine. Because this is a single boiler per turbine installation no nonreturn valve is needed. Steam flow can be controlled by one 12-in. motor-operated gate valve near the boiler. This valve may be operated from either the boiler board or the turbine board as well as at the valve itself. An emergency control station for this valve is located in the old station.

To prevent waste of steam during boiler warm-ups a crossover connection to the 340-psig system is provided.

Heat Balance. The heat balance diagram (p 75) shows that the condensate pumps force the condensate through the air-ejector condensers and the low-pressure closed heater to the deaerator, which has 46-psig pressure at full load. After leaving the deaerator the water pressure is raised to about 450 psig by the booster pumps. It then passes through the intermediate- and high-pressure heaters to the boiler feedwater-pump suction. From the boiler feed pump the water flows directly to the economizer at about 1850 psia.

A 21,000-gal surge and storage tank connects between the air ejector and the low-pressure heater into the condensate line, but the deaerator pressure is too great to permit this tank to float on the line. Instead a Bailey automatic condensate control operates air-operated valves installed in the condensate line before the deaerator and another in the roof-tank riser. Deaerator-storage-tank water level determines the opening of these valves. Water level rising above normal opens the roof-tank riser valve and closes the deaerator valve, forcing water to the roof tank.

Falling deaerator-water level opens wide the deaerator valve and closes the roof-tank valve. Water from the roof tank returns to the system through a connection to the top of the main condenser, the flow being regulated by an air-operated valve controlled by the hotwell level.

This arrangement permits some recirculation through condensate pumps and ejector condensers at all loads below maximum. An emergency pump can pass water directly from roof tank to deaerator. This pump operates automatically when deaerator-water level falls to a low point, or it may be operated manually from the turbine control board.

FEEDWATER HEATING SYSTEM

Heaters. The low-pressure heater, of the horizontal type, receives the gland leakoff steam from the high-pressure turbine as well as the low-pressure bleed steam. The intermediate- and high-pressure heaters are of the vertical type. All three heaters are of the floating-head removable-bundle design; the bundles may be removed without first removing the shell cover. Low- and intermediate-pressure heater tubes have Admiralty metal tubes, and the high-pressure heater has 70-30 copper-nickel tubes.

A bypass is arranged around both the higher-pressure heaters so one alone cannot be removed from service. Bypass and shutoff valves are all motor-operated from the control board.

Extracted steam passes to the heaters through motor-operated Thrustor valves that close on reverse flow, or when the

throttle valves trip, or from high water in the heaters. Level regulators through air-operated diaphragm-control valves supervise heater drain flow.

High location of the deaerator insures ample head on the booster-pump suction. Thrustor valves supervise bleed steam flow to this heater also. The equipment has a 1,000,000 lb per hr rating including a 2370-cu-ft storage tank with a capacity of about 140,000 lb at normal water level.

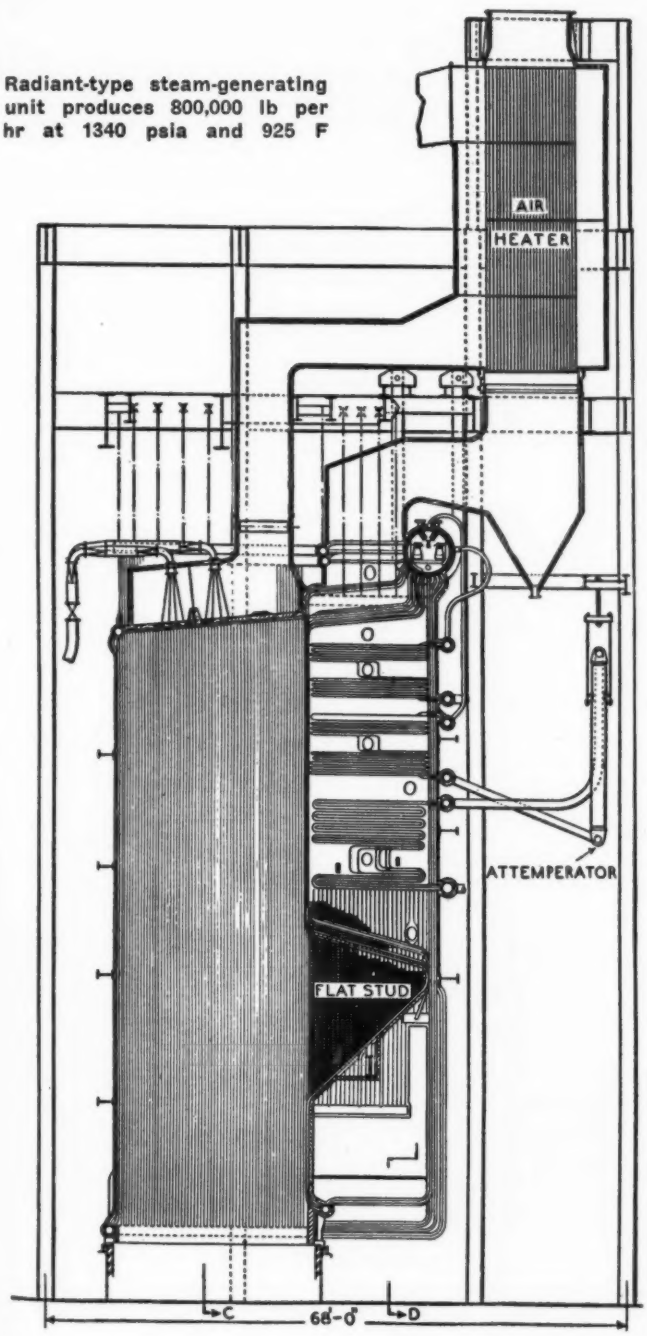
A 531-sq-ft straight-tube single-pass vent condenser serves the deaerator. There are two 6-in. Consolidated relief valves, a 12-in. Belfield overflow control valve and one 4-in. Chapman vacuum breaker.

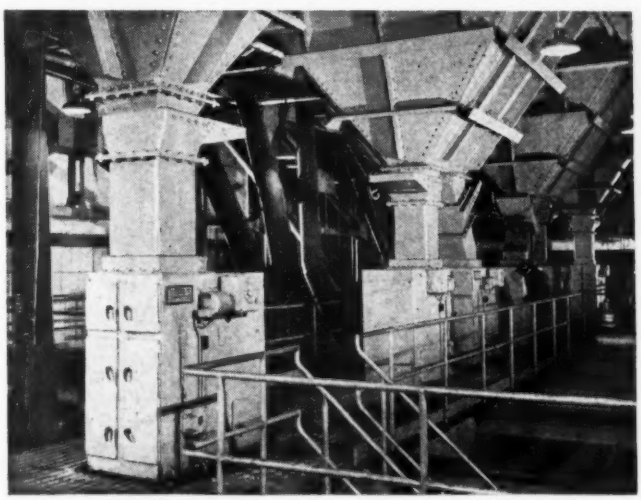
The cast-iron trays for both heating and deaerating sections are standard Elliott step type, which one man can handle readily. Deaerator maximum working conditions are 50 psig and 340 F.

Pumps. The three motor-driven 4-stage booster pumps, of 500,000-lb-per-hr capacity each, raise the water pressure to 450 psig after leaving the deaerating heater. Remote-controlled motor-operated discharge valves regulate flow. Motor drives are started and stopped from the control board with no provision for automatic control.

Three motor-driven 7-stage boiler-feed pumps raise the water pressure from 440 to 1840 psig after it leaves the high-pres-

Radiant-type steam-generating unit produces 800,000 lb per hr at 1340 psia and 925 F

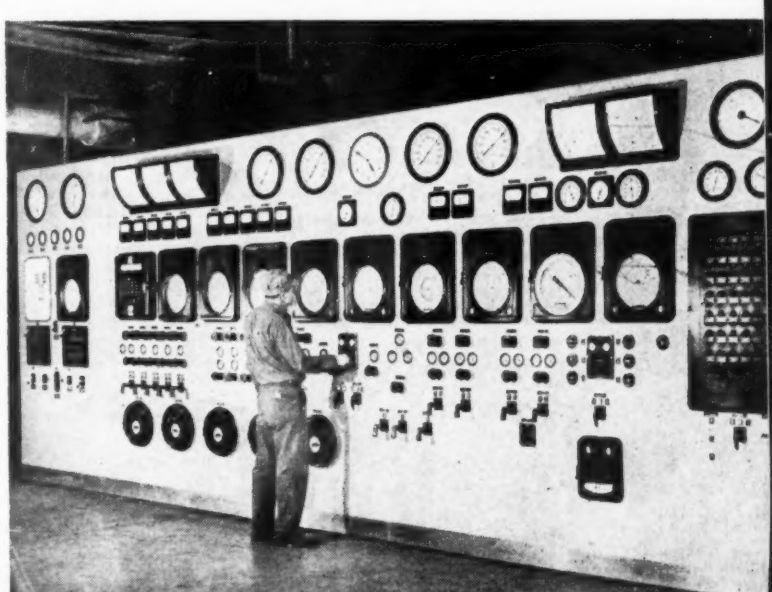




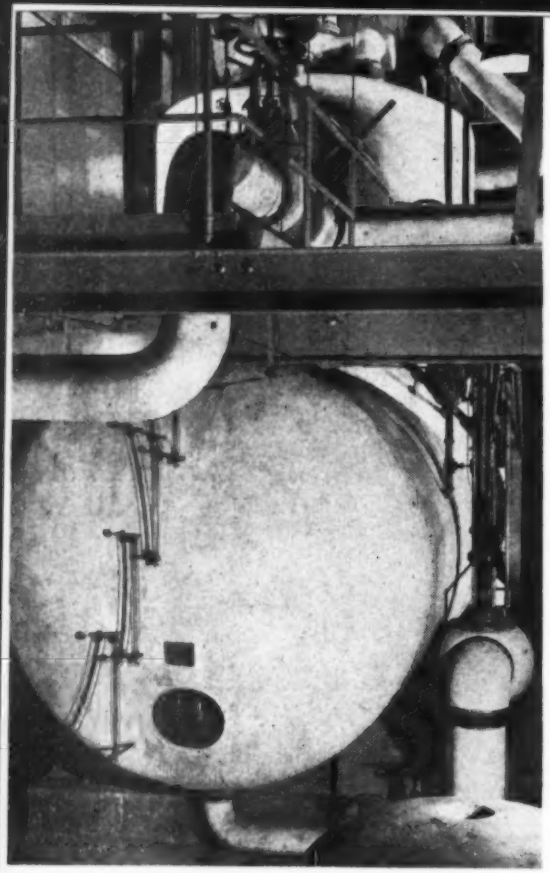
Coal-bunker hoppers and coal scales supply the pulverizing mills below. Burner pipes and boiler wall in the background

Springdale Station—Boiler No. 77
Expected Steam-Generator Performance

Steam output	1000 lb per hr	400	800
Coal input	1000 lb per hr	39.9	76.7
Steam pressure at superheater outlet	psig	1325	1325
Steam pressure in boiler drum	psig	1338	1375
Temperatures:	deg F		
Steam leaving superheater		925	925
Gas leaving economizer		585	700
Gas leaving air heater		343	398
Water entering economizer		380	430
Water entering drum		442	495
Air entering air heater		110	110
Air leaving air heater		490	538
Excess air leaving economizer	percent	30	25
Over-all steam-generator efficiency	percent	87.23	86.65



Control board for the steam generator. Automatic sequentially operated soot-blowing control is at the extreme left



1,000,000-lb-per-hr deaerator with 2200-cu-ft capacity is operated at 46.2 psia

Acknowledgment: Appreciation is expressed to coworkers G C Spray and J T Rummell who contributed material used in the preparation of this article.

sure heater. These pumps are also operated from the control board. Bailey control bypasses the pumps when load falls to about 15% of capacity. No differential-pressure control is provided since the entire duty is taken up by the Bailey 3-element feedwater control.

WATER-SUPPLY SYSTEM

Makeup System. The one evaporator has more than sufficient capacity to take care of ordinary makeup needs, but since no tie exists between new and old condensate systems no makeup source would be available when this evaporator goes out of service. For this condition a line connects the steam-condensate discharge from the 100-psig heater of unit No. 6 to the deaerator of the new unit No. 7. Since this condensate originates from No. 6 evaporator steam, feed pumps and live low-pressure steam, it has suitable high purity for use as makeup.

Three 65,000-gal storage tanks maintain a reserve condensate supply. Tank 71 supplies the old station; tank 72 holds boiler filling water and may be used in emergency for the old station; tank 73 supplies the new unit through two 500-gpm pumps. No connection exists between the last tank and the first two.

Overflow from the condensate roof tank of the new unit may be led to any of the three tanks. If tank 73 water is needed for any reason to take care of the old station, it may be pumped to the roof tank and from there overflowed to the other two tanks. Two filling pumps transfer the water from tank 72 to boilers out of service. When ready for service the boilers start with this water. If the boiler shows leakage the water can be returned to tank 72 and used again.

Service Water. The intake tunnels supply the raw service water through two 2500-gpm 80-ft-head pumps. These pumps discharge against a standpipe with an overflow and supply two generator-hydrogen coolers and two turbine-oil coolers. During operation one hydrogen cooler may be taken out of service by reducing turbine load to 85% or less.

Hydrogen- and oil-cooler discharge water together with the standpipe continuous overflow goes to a concrete service-water tank located under the floor. Two high-level service pumps, designed to deliver 2500 gpm against 300-ft head, raise water from the service tank to a 3000-gal bearing-water tank located in the stack base, 160 ft above the floor. This tank and its riser supply water to the fan bearings, precipitator hydro-mix valves, pulverizer-mill blowers and the ash-service line.

Low water in the standpipe causes an

Principal Power-Plant Equipment

STEAM GENERATOR AND AUXILIARIES:

Boiler.....Babcock & Wilcox Co
Radiant type, 800,000 lb per hr, 1550-psig design pressure, single drum, entirely suspended from building block-and-plaster casing steel

Attemperator.....Babcock & Wilcox Co
Six thermal-type spray nozzles each with Bailey control valve, superheater-outlet steam temperature 925±10 F between 400,000 and 800,000 lb per hr

Air preheater.....Babcock & Wilcox Co
108,000 sq ft, tubular, vertical, welded element

Economizer.....Babcock & Wilcox Co
18,800 sq ft, steel, continuous tube, 1650-psig design pressure

Superheater.....Babcock & Wilcox Co
34,660 sq ft, continuous, self-draining, outlet steam 1325 psig, 925 F

Burners, 10, two connected to each of 5 mills..Babcock & Wilcox Co

Pulverizing mills, 5.....Babcock & Wilcox Co
10-ton capacity each; grinding elements are steel balls between rotating lower ring and stationary upper ring; adjustable grinding pressure

Coal feeder, one per mill.....Babcock & Wilcox Co
Constant speed at either 5 or 2½ rpm

Forced-draft fans, 2.....B F Sturtevant Div
132,000 cfm, 135-F inlet, 13-in. static pressure, 1175 rpm, vane control

Induced-draft fans, 2.....B F Sturtevant Div
230,000 cfm, 425-F inlet, 10.9-in. static pressure, 695 rpm, vane control

Flyash precipitator.....Research Corp
Electrostatic, wire and perforated-plate electrodes, 95% efficiency

Soot-blower system.....Vulcan Soot Blower Corp
Automatic sequentially operated; 4 retractable units, 12 rotary units, operated by air at 80 to 125 psig. Blowing steam 16,500 lb per period at 300 psig and 700 F

Coal-screening hopper, one per mill.....Stock Engineering Co

Ash pump.....Allen-Sherman-Hoff Co
6x6 in., 1175-gpm ash-laden solution through 1200 ft of 6-in. pipe

Ashpit water-supply pump.....Byron Jackson Co
Deepwell turbine-type, 1500 gpm at 1180 rpm, 39½-ft dynamic head

Boiler-starting fuel-oil pump.....The Viking Pump Co

Economizer recirculating pump.....The Hankison Co
1½x2 in., 70 gpm at 600 F and 100-psig differential pressure

Ashpit sump pump, 2.....Allen-Sherman-Hoff Co
300 gpm, 40-ft dynamic head, remove surplus water from ash system

Ash-settling basin sump pump, 2.....Goulds Pump Inc
Submerged centrifugal, 500 gpm at 1150 rpm, 35-ft total net head

Ash-water standpipe.....Connery Construction Co

Bearing-water tank, f-d and i-d fans.....Connery Construction Co

Continuous-blowdown flash tank....Pittsburgh Piping & Equipment Co

Flyash disposal hydro-mix valves, 20.....Allen-Sherman-Hoff Co

Ash-handling system, including pyrites transport Allen-Sherman-Hoff Co
Includes ash sluice, two feed chambers, ash sump, bilge sump and sluice for handling mill rejects to ash sump

Mill-level control, 2-speed, intermittent feed.....Bailey Meter Co

TURBINE-GENERATOR AND AUXILIARIES:

Turbine-generator.....Westinghouse Electric Corp
Normal rating, 65,000 kw, full-load 81,250-kw, 3600 rpm, 2-cylinder tandem-compound double-flow impulse-reaction, steam from 1250 psig and 925 F to 1.5 in. Hg abs, bleed points at 11th, 18th, 24th, 28th stages. Motor-driven turning gear, low-vacuum trip, two explosion doors. Generator is rated at 81,250 kva, 11,500 v, 0.9 short circuit ratio, hydrogen cooled at ½ psig; with 15 psig, generator capacity is 93,440 kva

Condenser.....Westinghouse Electric Corp
50,000 sq ft surface, single pass, radial type, divided water boxes, arsenical Admiralty tubes

Air ejectors, 2-stage, 2.....Westinghouse Electric Corp

Condenser circulating-water pumps, 2.....Westinghouse Electric Corp
48-in. vertical-discharge propeller type; 48,750 gpm each at 495 rpm with 2 pumps operating; 61,000 gpm with 1 pump operating

Hydrogen cooler.....Westinghouse Electric Corp
3480-sq-ft surface type, mounted inside main-generator housing

CONDENSATE AND FEEDWATER SYSTEM:

Condensate pumps, 2.....Westinghouse Electric Corp
Three-stage vertical-centrifugal, 1400 gpm at 1170 rpm, 300-ft dynamic head

Low-pressure feedwater heater.....American Locomotive Co
2970 sq ft, horizontal, floating head, 4-pass

Deaerator.....Elliott Co
1,000,000-lb-per-hr capacity, 2200-cu-ft water storage, 50-psig design

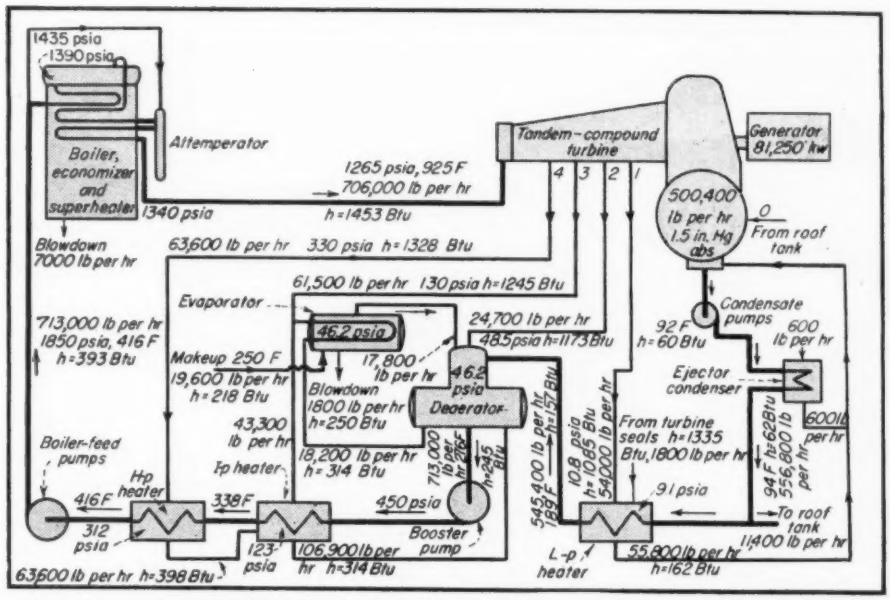
Booster pumps, 3.....Allis-Chalmers Manufacturing Co
1080 gpm, 50-psig suction, 450-psig discharge, 4-stage

Intermediate-pressure feedwater heater.....American Locomotive Co
2380 sq ft, vertical, floating head

air-operated valve to open, permitting water to pass from the old raw-water roof tanks to the standpipe. A 200-gpm pump supplies water to the bearing-water tank in emergencies.

Fuel Supply. To supply 1000 tons of coal daily for the new generating unit changes in coal-handling machinery were made and added mining equipment of greater capacity was installed at the Springdale Mine of Allegheny Pittsburgh Coal Co. This mine, a subsidiary of the West Penn Power Co, is located directly across the river from the station.

Designed and purchased were three hundred 8-wheel all-steel mine cars having double the capacity of the replaced cars. Also added in the mine were two mine locomotives, two mechanical coal-loading machines as replacements and an electrically operated rotary mine-car dump for necessary handling capacity.



At full load of 81,250 kw expected turbine-cycle heat rate equals 9230 Btu per kw-hr for unit No. 7. Heater-water pressure of last two heaters is below 500 psia

ELECTRICAL EQUIPMENT

Main Generator. Nominally rated at 65,000 kw with 80% pf, 11,500 v and 3600 rpm the main generator can develop 81,250 kva with ½-psig hydrogen pressure and 93,440 kva at 15-psig pressure. A separate dually driven exciter provides excitation. Provision has been made for future excitation from either an electronic exciter or a direct-connected shaft exciter.

Station Auxiliaries. An Allis-Chalmers 7500-kva 11/2.3-kv outdoor transformer supplies the new unit's auxiliary drives, which are all electrical. It connects through gang-operated load-break disconnect switches to the generator terminals. The transformer low-tension side connects to two 2300-v switchgear cubicles located between the turbine and boiler sections. Only one breaker per feeder is provided and the various turbine and boiler circuits of corresponding service are divided between them for flexibility and continuity of operation.

Springdale Station, West Penn Power Co

High-pressure feedwater heater.....American Locomotive Co
3200 sq ft, vertical, floating head
Boiler feedwater pumps, 3.....Byron Jackson Co
7-stage, 500,000 lb per hr at 3585 rpm, 440-psig suction, 1840-psig discharge, water temperature 430 F
Condensate roof tank, 20,000 gal.....Connery Construction Co

MAKEUP, TREATMENT AND SERVICE-WATER SYSTEMS:

Sweet-water tank, 65,000 gal.....Connery Construction Co
Sweet-water tank, 65,000 gal.....Pittsburgh-Des Moines Steel Co
Boiler drain tank, 65,000 gal.....Pittsburgh-Des Moines Steel Co
Boiler-fill pump, 2, 8-stage 600 gpm.....Byron Jackson Co
Sweet-water pumps, 2, 3-stage, 500 gpm at 3450 rpm.Ingersoll-Rand Co
Evaporator-feedwater deaerator, 1.....Elliott Co
Vertical, 125,000 lb per hr at 10-psig pressure
Evaporator-feedwater-deaerator pump, 2.....Ingersoll-Rand Co
Single-stage, 1400 gpm at 1750 rpm, 85-ft total dynamic head
Evaporator feedwater pump, 2.....Ingersoll-Rand Co
Two-stage, 250 gpm at 3500 rpm, 480-ft total dynamic head
Evaporator.....Griscom-Russell Co
17,800 lb per hr vapor at 35 psig from feedwater at 250 F, with 18,080 lb per hr steam at 122 psig and 460 F condensed in tubes
Evaporator vapor steam-purifier.....Cochrane Corp
Water-softening unit.....The Permutit Co
Zeolite, 7 ftx11-ft, 9-in. shell, 90,000 gal water in 6 hr
Softened-water booster pump, 250 gpm, 3450 rpm....Ingersoll-Rand Co
Zeolite water-softening brine pump, 10 gpm, 1750 rpm.....Deming Co
Chemical feed tank.....Pittsburgh Piping & Equipment Co
Bearing-water auxiliary pump.....Ingersoll-Rand Co
Single-stage, 200 gpm at 3450 rpm, 65-ft total dynamic head
Fire pump, 2, 1000 gpm at 1775 rpm, 125-psig total pressure.....
Buffalo Pumps, Inc
Boiler-feed-pump gland-sealing water pump, 30 gpm..Byron Jackson Co
High-level service-water pump, 2.....Byron Jackson Co
Deepwell turbine type, 4-stage, 2100 gpm at 1750 rpm, 334-ft head
Service-water intake pump, 2.....Byron Jackson Co
Deepwell turbine type, 1 stage, 2500 gpm at 1750 rpm, 80-ft head
Low-level service-water standpipes, 2.....Connery Construction Co
Gland water-supply tank.....Connery Construction Co
Gland water-drain tank.....Connery Construction Co

INSTRUMENTS AND CONTROLS:

Temperature indicators, 2.....Leeds & Northrup Co
Automatically balanced, double range, potentiometer type, 50 points
Conductivity recorders, 2, multipoint.....Leeds & Northrup Co
Multipointer gages, dry diaphragm.....Bailey Meter Co
Steam-flow air-flow meter and various flowmeters.....Bailey Meter Co
Drum-water-level recorders, 2.....Bailey Meter Co
Three-element feedwater control.....Bailey Meter Co
Feedwater-pump bypass control.....Bailey Meter Co
Superheat control.....Bailey Meter Co
Temperature recorders, resistance element, electronic..Bailey Meter Co
Combustion control.....Hagan Corp
Feedwater-heater level control, Hagan-Bailey arrangement.Hagan Corp
Heater drain control.....Hagan Corp
Hotwell-level control.....Hagan Corp
Condenser circulating-water differential transmitter.....Hagan Corp

GENERAL STATION EQUIPMENT:

High-pressure piping.....Pittsburgh Piping & Equipment Co
High-pressure valves.....Walworth Co
Low-pressure valves.....Reading, Pratt & Cady Div
Circulating-water valves.....Chapman Valve Co
Coal scales.....Stock Engineering Co
Flues and stack.....Connery Construction Co
Principal motors..Allis-Chalmers, General Elec, Westinghouse, Elliott
Insulation.....Johns-Manville Co
Flood pump, 2150 gpm at 1180 rpm, 30-ft head.....Byron Jackson Co
Oil filter pumps, 2, 18 and 28 gpm..Worthington Pump & Machinery Corp
Sump pumps, 2, 500 gpm, 1150 rpm, 40-ft head....Yeomans Brothers Co
Sump pump, 24 gpm, 1750 rpm, 20-ft head.....Deming Co
Passenger elevator, 2000-lb capacity.Westinghouse Electric Elevator Co
Structural steel.....Bethlehem Steel Co
Brick, facing.....Standard Clay Products
Brick, glass.....Pittsburgh Plate Glass Co
Tile, unglazed facing.....Stone Creek Brick Co
Louvers and ventilators.....H H Robertson Co
Steel grating.....Reliance Steel Products Co
Temporary south wall.....Johns-Manville Co
Precast concrete roof.....Lastik Products Co
Roofing, built-up waterproofing.....Limbach Co
Steel sash.....Truscon Steel Co

How To Calculate

Vital to economical load division among generating stations is a knowledge of the additional costs incurred by adding blocks of generation on each station. Here are methods of finding relation between incremental cost and incremental output*

By M J STEINBERG
Division Engineer, System Engineering Dept
Consolidated Edison Co of New York, Inc

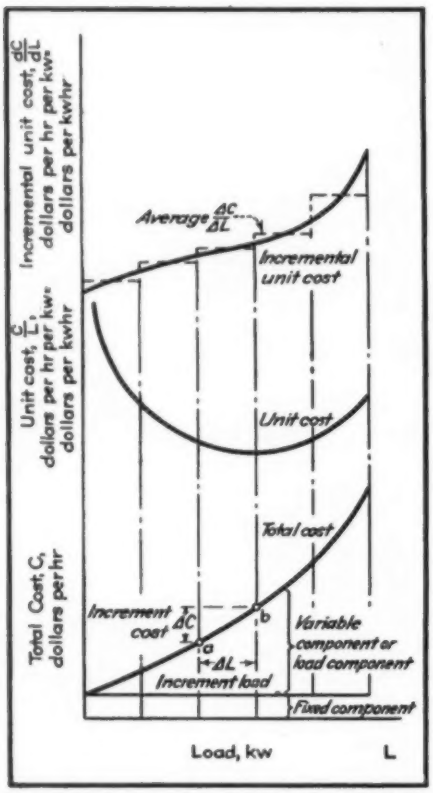


Fig. 1—Preferable method of finding incremental production costs, when possible, is based on correlation of hourly cost rate and constant kilowatt output

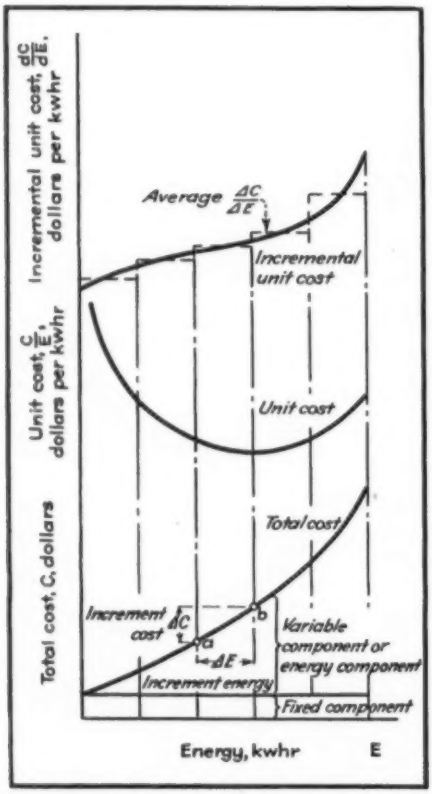


Fig. 2—While not precise, incremental production costs must at times be found from curve faired through plot of total cost vs total output for given periods

► WITH UNIVERSAL RECOGNITION that the use of incremental rates should guide economy loading of power plants, many practical problems arise relating to the determination and application of incremental plant performance, whether expressed in monetary or thermal units. This involves establishing incremental costs for fuel, labor, supplies and maintenance—major production-cost components for electrical energy.

Cost Terminology. Before discussing these components the term, cost, should be clarified because there are many kinds, such as *total cost, unit cost, average cost, incremental cost, fixed-cost component, variable-cost component.* Of these, the basic cost is the total cost from which the others can be derived when the variation with either kw load or kwhr energy is known. Fig. 1 and 2 show typical cost variations with load and energy.

Total cost curves have two components: (1) The fixed component commonly known as the *no-load intercept* has a constant value and is independent of the load or energy. (2) The variable component depends on the magnitude of the load or energy. For any two points on the curve, such as *a* and *b*, the difference in cost is the increment cost, and the difference in load or energy is the increment load or increment energy.

The unit cost is an average cost obtained by dividing the total cost by the corresponding load or energy.

The incremental unit cost is the ratio of the increment costs to correspondingly *very small* increments of load or energy resulting in the smooth curves shown, Fig. 1 and 2. To save calculating time it is customary to use average incremental unit costs obtained by dividing increment costs by corresponding sizable increment loads or energies resulting in the stepped type of curve shown.

Fig. 1 and 2 show similarity in form but differ in that Fig. 1 is plotted against kw load and Fig. 2 against kwhr energy. *Load* is the *time rate* at which energy is transferred or transformed. Hence the costs plotted against load must be stated in time rates as indicated. Energy, as used here, is the electrical equivalent of work and is calculated as the product of the load and the time during which that load is maintained. Costs are the total incurred in that time.

Of the two methods of presenting production costs Fig. 1 is preferred because it is independent of load cycle. The method of Fig. 2 should be used only as a last resort because production costs for a given energy output magnitude may vary substantially depending on the load-cycle variation. Fig. 3 shows this effect for four assumed monthly load cycles. For each cycle the monthly energy is the same, but the production costs for the month vary over a wide range.

Production Costs. Of the four cost components, fuel, labor, supplies and maintenance, the first is the most important since it amounts to about 60 to 80% of total production cost. Fortunately fuel cost can be calculated with a precision that checks actual performance to within ± 1%. Fuel costs are derived from plant thermal performance, usually expressed in Btu per hr input for given kw load, and may be shown as curves similar to Fig. 1. Because ample literature describing methods for deriving incremental fuel costs is available this item will not be discussed further.

Total production-cost curve can be divided into fixed and variable components. The fixed component can include all charges that do not vary with load. Labor costs can be included in this category because usually the amount

* From a paper read before the May 29, 1946, Harrisburg, Pa., meeting of the Pennsylvania Electric Association.

Incremental Production Costs

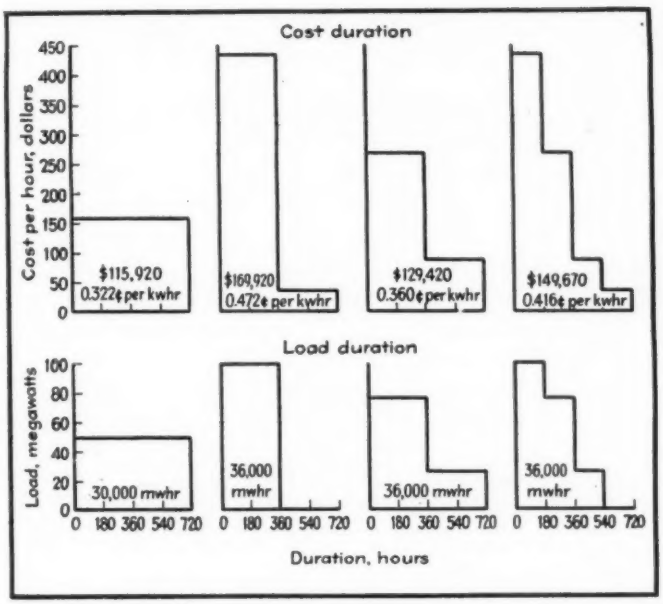


Fig. 3—Total monthly output of 36,000 mwhr can have wide range of production cost even though each load value incurs a fixed hourly cost rate. Monthly cost depends on load cycle; that is, on the number of hours operated at each load

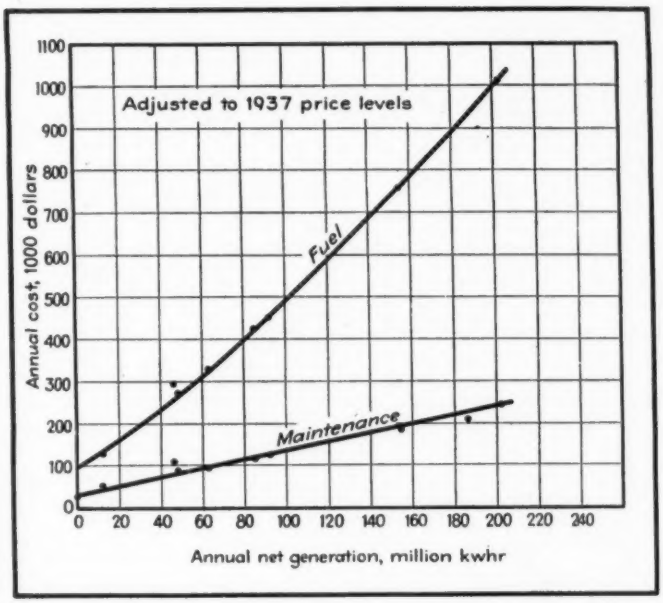


Fig. 4—Variation of production costs with annual output for an actual power plant during the years of 1922 to 1930 inclusive, adjusted to common price level of 1937. These generating-cost curves are of the type shown in Fig. 2

of equipment placed in service will influence them directly. Operation of additional boilers, turbines and auxiliaries to supply an increment of load may require additional operating personnel and within the limits of capacity so added, the incremental labor costs will be fixed and independent of increment load supplied by the generating station.

For the supply cost, analysis indicates that the average unit cost per kwhr remains relatively constant, justifying the assumption that the incremental unit cost equals the average unit cost. This assumption introduces no appreciable error because of the item's smallness relative to total production cost.

MAINTENANCE COSTS

Up to the present time no method has been developed to express maintenance cost in terms of a time rate as in Fig. 1. Arbitrary methods must be used to determine incremental maintenance costs, generally based on average costs taken from records of account, and can be represented as in Fig. 2. Incremental maintenance costs should exclude the fixed-cost component. The accounting records can be used to break down the costs applicable to the power-plant components, such as building, structures, fuel- and ash-handling equipment, boiler- and turbine-room equipment, electrical apparatus. Judgment then determines whether changes in annual generation affect each class of equipment, those items not affected being excluded. For the equipment judged to be affected by generation variations, the average unit maintenance costs are considered as the incremental maintenance costs. For a more detailed discussion of this method see "Analyzing Steam Plant Increment Costs" by Paul B Metcalf, *Electrical World*, Feb 26, 1938.

For an electric system consisting of a relatively large number of power plants, the foregoing method becomes unwieldy. For simplicity in billing, the most convenient way pegs the incremental maintenance cost as a percentage of the incremental fuel cost for the system as a whole. This method as applied to a large system is discussed in the remainder of this article.

A power plant was selected whose annual generation reduced gradually over a period of years until the plant was shut down and ultimately retired. This plant was chosen because no equipment was added or removed during this period. There were no major changes in design to affect the efficiency or plant performance; hence any performance changes were caused solely by variations in annual generation. From records of account, the total annual fuel and maintenance costs, adjusted to price levels as of some particular year, were plotted as a function of annual generation, Fig. 4. Some judgment must be exercised in respect to maintenance costs. Where extraordinary or deferred maintenance costs exist, the costs should preferably be plotted as 5-year running averages. From the data assembled, the ratios of annual maintenance to annual fuel costs were derived and plotted as in Fig. 5.

DERIVING COST CURVES

Using conventional methods, incremental fuel- and maintenance-cost curves, Fig. 6, were derived from the annual cost curves of Fig. 4, as well as the ratio of incremental maintenance to incremental fuel costs. The incremental-costs ratios were then plotted against the annual-costs ratio, as in Fig. 7, from which incremental maintenance costs as a percentage of incremental fuel costs could be determined for any value of annual maintenance cost expressed as a percentage of the annual fuel costs. This established the relation between incremental and annual maintenance costs,

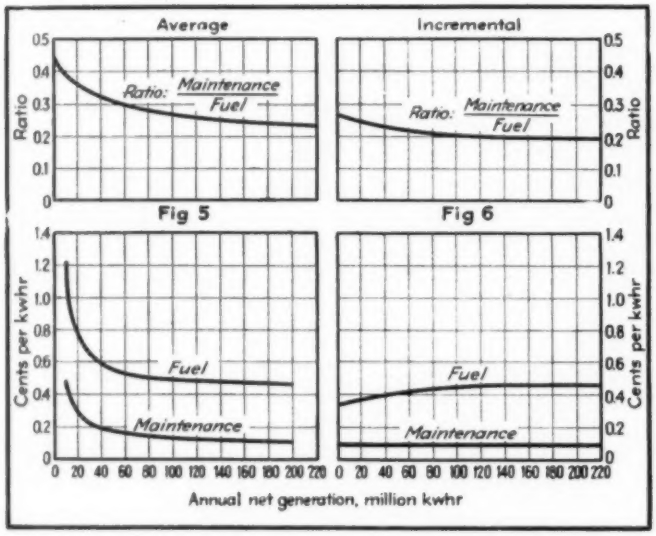


Fig. 5—Variation of average unit costs and their ratio with annual output derived from Fig. 4. Fig. 6—Variation of incremental unit costs and their ratio with annual output derived from Fig. 4. Note difference from Fig. 5

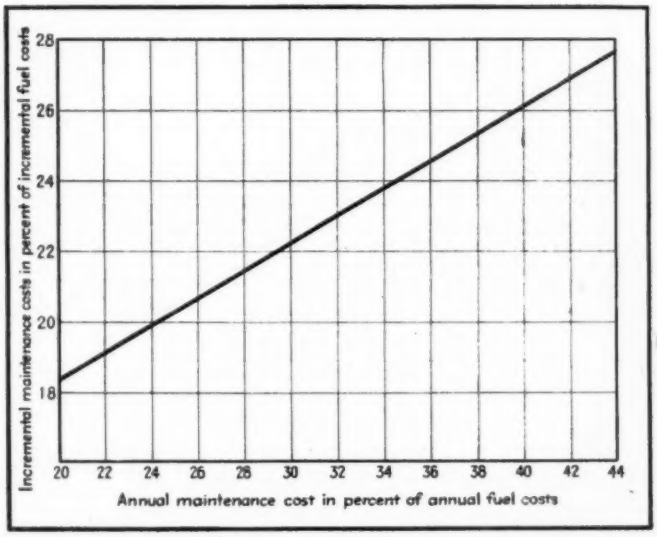

Incremental maintenance costs in percent of incremental fuel costs
Annual maintenance cost in percent of annual fuel costs

Fig. 7—Relation between ratio of incremental costs from Fig. 6 and ratio of average unit costs from Fig. 5 can be expressed as a straight line. This simple correlation allows easy application to actual station production costs

which was simple to apply in practice.

It is not intended to imply that the annual maintenance costs of the selected plant are representative of costs for other plants or for the entire system, since operating conditions, design and load cycle are factors that may cause considerable variation in annual maintenance costs. The writer believes, however, that some relation between annual maintenance and annual fuel costs exists, which in turn governs the relation between the corresponding incremental costs as shown in Fig. 7. In other words, Fig. 7 indicates relative rather than absolute values and it remains to be seen whether this curve, derived from a selected plant, is also applicable to the entire system.

Fig. 8 shows the ratio of annual maintenance to annual fuel costs for the entire system as a function of the fuel price alongside. These values, covering a period of 16 years, are based on values of record without adjustment to price levels of some particular year. For this system the variation in the ratio of annual maintenance to fuel cost lies within a narrow band which is further reduced when plotting 5-year running averages. It appears that the ratio of annual costs is not materially affected by variation in fuel price. This demonstrates the probability that price levels for maintenance labor and materials vary in proportion to fuel-price levels.

Variation in thermal efficiency, which directly affects annual fuel costs, appears to have no effect on the ratio of annual maintenance to fuel cost. One explanation may be that thermal-efficiency improvement, whether the result of improved operating procedure or additions of more efficient equipment, and the resulting reduction in annual fuel costs, is also accompanied by a reduction in annual maintenance costs without mate-

(*Continued on page* 146)

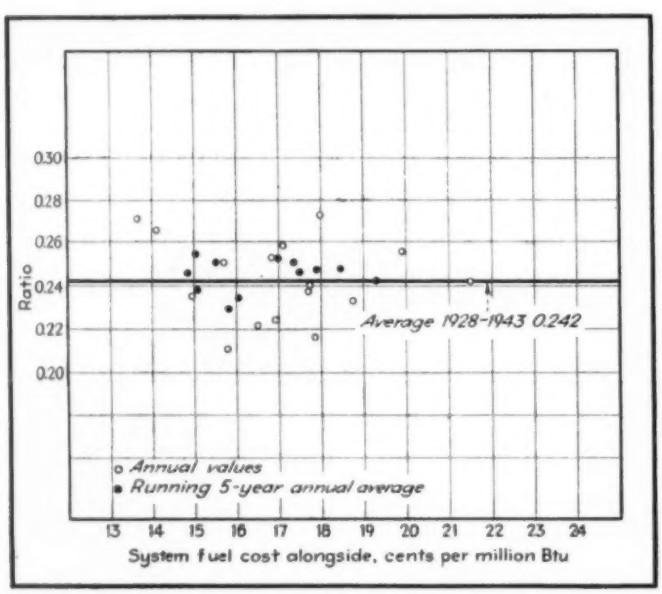

Ratio
Average 1928-1943 0.242
o Annual values
• Running 5-year annual average
System fuel cost alongside, cents per million Btu

Fig. 8—Ratio of annual maintenance to annual fuel costs for system comprised of several plants lie in narrow band showing no significant variation with changing fuel price

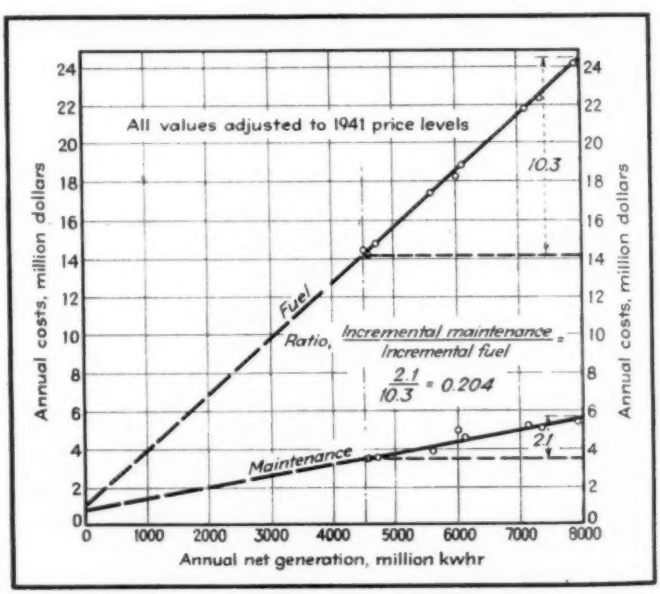
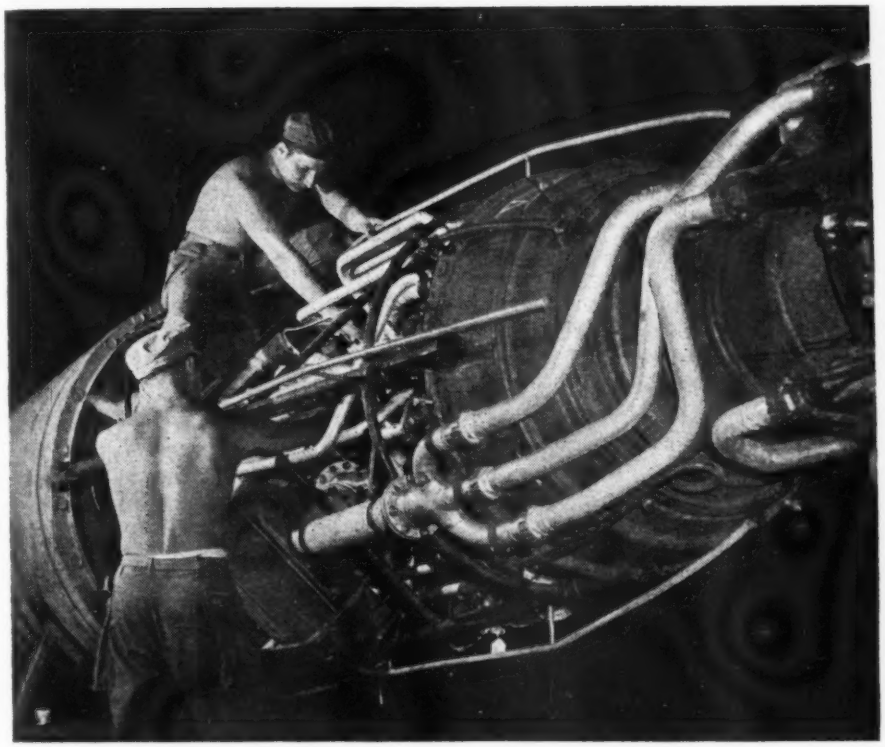

All values adjusted to 1941 price levels
Annual costs, million dollars
10.3
Fuel
Ratio, Incremental maintenance / Incremental fuel = 2.1 / 10.3 = 0.204
2.1
Maintenance
Annual net generation, million kwhr

Fig. 9—Variation of system annual fuel and maintenance costs with generation for 1933 to 1941 adjusted to common price levels, showing derivation of incremental cost ratio

Power Beyond the Stratosphere



Technical details on the power plant that propels V-2, Germany's rocket bomb now undergoing Army Ordnance tests. Novel methods of steam and power generation plus good application make the plant interesting to all power men

▶ RECENTLY at White Sands proving grounds in New Mexico, the U. S. tested Germany's practical application of the proverbial "bolt from the blue," the dreaded V-2 rocket bomb. This test was one step in our Army Ordnance program to uncover all the know-how on rockets developed over a 12-year period by the Germans and demonstrated by this so-called bomb of the future. E J Tangerman, former managing editor of POWER and a McGraw-Hill representative at the firing test, here supplements other data on the V-2 published in POWER, Feb 1945, p 99.

THE ROCKET

At that time it was known that V-2 was truly a rocket bomb. That is, it drew all its power-supporting fuels from its own reservoirs, unlike a turbojet which relies for some of its propelling gas on surrounding atmosphere. These reservoirs supply sufficient combustibles to propel at a maximum speed of 3800 mph (5600 fps) a rocket that is 46 ft long and 5.4 ft maximum dia, with a load of 28,380 lb when fully fueled. In order of arrangement through its 46-ft length come a nose or warhead, control compartment, fuel tanks, turbine and pumps and a combustion-chamber-venturi nozzle assembly that constitutes the engine.

Fuel Tanks. Of these the cylindrical, dome-ended fuel tanks, one below the other, take up 20.2 ft. The upper or ethyl-alcohol tank, 255 lb with fittings, tapers toward the nose. The lower or oxygen tank, 375 lb with fittings, is built of the same material, aluminum alloy of a graduated thickness. Reduction in weight results from this method of fabrication, but full fuel weight can be carried only when the rocket stands upright. Both tanks also operate under pressure to prevent tank collapse from atmospheric pressure as fuel is used up. Pressure for the alcohol tank comes during initial burning stages from an aperture in the rocket's nose that supplies air-ram pressure until lower density regions are reached. At this point the air line shuts off and nitrogen from cylinders within the rocket maintains pressure on the alcohol within the tank.

Pressure on the oxygen tank comes from vaporizing a small quantity of liquid oxygen. During early stages while chilling the heavily insulated oxygen tank down to thermal equilibrium (—361 F) it is estimated that 4.5 lb of oxygen boil off each minute. A large vent valve in

Rocket in upright position for launching. The fins cover all the power bay

this tank prevents excessive pressure from building up during this period. When burning is under way a small quantity of liquid oxygen evaporated in a heat exchanger within the rocket maintains desired pressure.

Expansion Allowance. Flow-control valves in 6-in.-dia outlets regulate fluid feed from tanks through brass expansion bellows of the same dia. Tubing, incased in double-walled glass-wool insulation, passes through the oxygen tank to carry alcohol to its pump.

TURBINE AND PUMPS

Pumps for both alcohol and oxygen lie in the 12.4-ft power bay. The oxygen pump delivers 153 lb per sec of oxygen at 381 psi at the outlet, and the alcohol pump develops a 410-psi pressure for a delivery of 123 lb per sec of alcohol at its outlet. Driving force for these pumps comes from a direct-coupled 580-hp 3850-rpm single-stage steam turbine.

This turbine, whose rotor, stator and blades are aluminum alloy, has an inlet flow of 5.4 lb per sec of steam through two rows of cast-iron nozzles at an estimated 360-psi inlet pressure. If at lightened loads the turbine should increase its speed, an overspeed trip operates at about 5000 rpm to cut off fuel flow to the steam producer.

Steam Generation. A 9x6 in.-dia steel container with hemispherical ends, called the steam producer, develops steam by the novel method of spraying into this chamber at predetermined rates a mixture of hydrogen peroxide and a permanganate solution (sodium, potassium or calcium) under the impulse of nitrogen under pressure. The permanganate serves as a catalyst to dissociate water from the peroxide with sufficient heat release to generate superheated steam at about 527 F. Steam moves through an asbestos-lagged steel line to a distribution ring near the turbine and from it to the turbine nozzles.

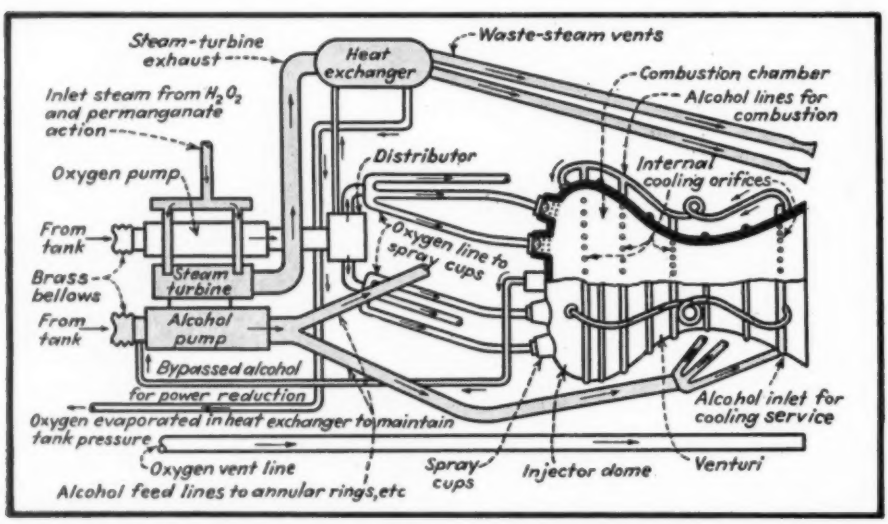
Steam and waste chemicals exhausted from the turbine enter a heat exchanger whose chief function is vaporizing a sufficient supply of bypass liquid oxygen for return to the oxygen tank where it maintains a pressure on this vessel. This heat exchanger serves further to reduce backpressure on the steam turbine. Steam leaving this heat exchanger exhausts through two 4.5-in. dural tubes that connect with two louvers in the rocket tail.

ROCKET ENGINE

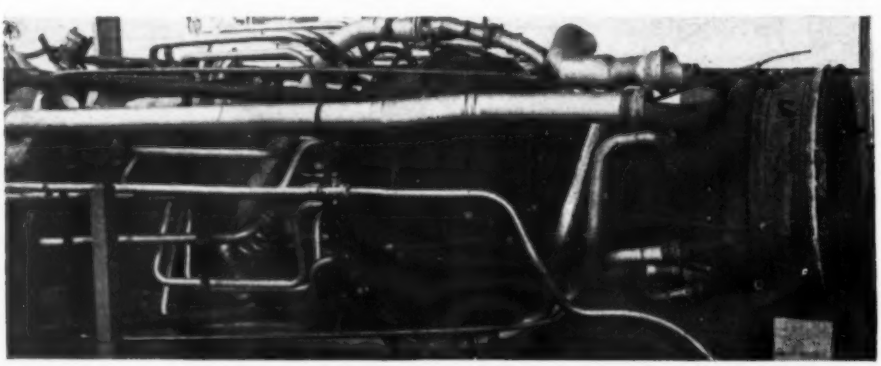
Below these power-plant auxiliaries, pumps, turbine and heat exchanger are a combustion chamber and venturi nozzle which together make up the rocket engine. The combustion chamber occupies the lower 6 ft of the power bay. Its dimensions are: maximum internal dia of 37.3 in., nozzle dia of 15.7 in. at the throat and 29.2 in. at the mouth. It weighs 1025 lb and, with accessories, valves and feed lines, totals 1975 lb. Entire assembly including combustion chamber, nozzle assembly and dome-shaped injector head is of a low-carbon steel comparable to SAE 1020. A jacket of the same material is welded to the engine and is concentric in form.

Cooling System. This jacket serves as a cooler. An annular ring at the lower end of the chamber-venturi assembly receives alcohol (about 10% of pump output) from 6 feed tubes. The ring directs fuel (1) into a row of coolant holes that spray a cooling film of alcohol on the inner wall of the nozzle at this point and (2) upward through the concentric cooling jacket into four externally mounted feed lines that supply three more annular rings around the engine before terminating at the top of the chamber in the injector dome jacket.

An alcohol return valve spotted in the center of the injector-dome jacket feeds back a portion of this coolant alcohol to the inlet side of the alcohol pump. This valve opens under nitrogen pressure when the V-2 approaches the required speed for attaining its preselected range. The released alcohol feedback at the inlet cuts down the injection rate of alcohol to the combustion chamber and reduces resultant power output by two thirds. Total shutdown occurs when the turbine system stops.



Diagrammatic view of auxiliary section and power bay that identifies chief components and indicates the flow of fluids into and out of the combustion chamber



Photograph of area covered by above sketch. Expansion bellows appear at extreme left; oxygen vent line across upper foreground and a parallel steam vent line

COMBUSTION CHAMBER

Now for the combustion chamber itself. Its upper region or injector dome has two concentric circles carrying 18 double-walled spray cups of about 6-in. dia at their external base. Spray from these cups converges at the chamber's center line.

A distributor located in the oxygen pump discharge routs liquid oxygen under 300 psi through 18 separate feed lines to each of the 18 spray cups. Here the liquid oxygen enters at the top, passes through an orifice system that vaporizes

(*Continued on page* 144)

Menasha Municipal Plant Installs First Supercharged Intercooled Diesel

▶ To the oldest diesel-engine municipal utility in Wisconsin goes the distinction of installing the first supercharged intercooled diesel in commercial stationary application in this country. The new 1100-hp Nordberg engine replaces one of two 1200-hp engines installed some years ago at the Menasha municipal generating plant.

Plant Growth. This plant, the history of which goes back more than 40 years, ranks as one of the oldest in the country. It started originally as a water-pumping station in 1905 with two 3-cyl 75-hp diesels belted to triplex pumps. In 1907, a generator was belted from one of the engines to provide street lighting and later a few homes were supplied. As load grew, there arose a demand for 24-hr service and a 225-hp engine was installed in 1911 and a duplicate in 1913.

In this latter year, litigation by the local public utility to prevent expansion of service shut the plant down for two years. The plant resumed operation after a court ruling in favor of the city, and took on all residential and commercial service. In following years, two 600-hp and two 1200-hp units were added. The new Nordberg engine replaces one of the latter. All units are 4-cycle, the earlier ones being of air-injection design and the new one mechanical injection.

Intercooled Supercharging. Special interest attaches to the use of intercooling of the supercharging air in the new engine. It is a 4-cycle unit, 16x22 in., and is supercharged by an Elliott-Buchi exhaust-gas turbocharger. Intercooling is accomplished between the turbocharger and power cylinders by a finned-tube cooler located back of the covers on the exhaust side of the cylinder block, see photo. Raw water from Lake Winnebago passes through the tubes while air from the turbocharger passes over the finned surface on its way to the cylinders.

Engine Performance. Intercooling reduces the temperature of the charge entering the cylinders and hence permits increasing engine output without exceeding temperature conditions known to be conservative. Tests made so far show that intercooling increases engine rating between 18 and 20% with the same mean temperature in the cylinders and the same average exhaust temperature. Air passing through the intercooler is cooled to within approximately 15 F of the cooling-water temperature, which at Menasha reaches a maximum of 80 F in summer. After passing through the intercooler, water goes to the lubricating-oil cooler, and then to the heat exchanger of the jacket-cooling system, before discharging to waste.

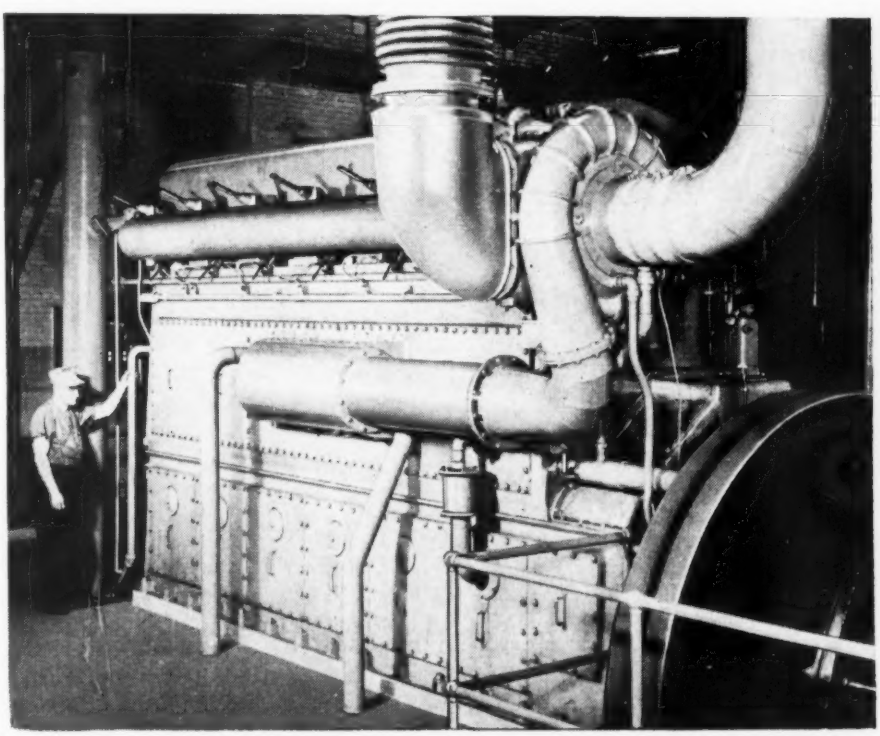
Foundation and Generator. Another interesting feature of the Menasha installation is the utilization of the old foundation and generator. This materially reduced cost of installation and permitted the new unit to be placed in service much earlier than if the old foundation had to be removed, a new one built, and a generator purchased at a time when electrical equipment was difficult to obtain. The old 850-kw generator was designed to operate at 300-rpm while the normal speed of the Nordberg engine is 327 rpm. Reducing engine speed to match generator characteristics lowered engine rating from 1200 to 1100 hp.

Although the foundation for the old 1200-hp engine was considerably larger than required for the new unit, it was of such shape and so located it could be used with minor alterations. Distance from shaft center to floor line ran about the same on the two engines. Cutting off 6 ft at one end of the foundation provided more room in the basement for engine auxiliaries. As original foundation bolts did not fit the new bedplate, holes were drilled in the concrete and new bolts grouted in.

Using the old generator presented no unusual problems and it was left in its original setting. The principal problem lay in lining up the holes in the generator and engine shaft flanges and reaming the holes for fitted bolts.

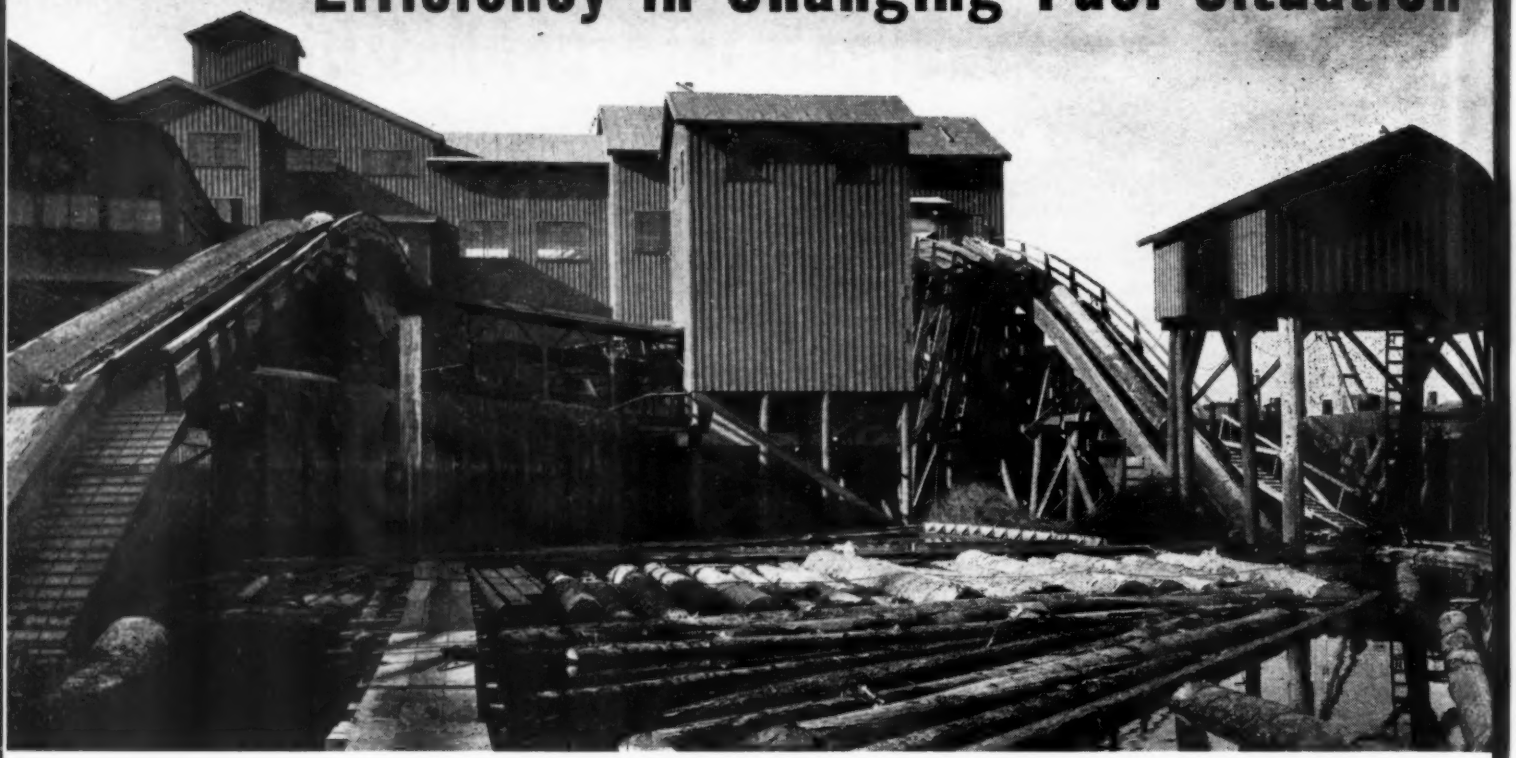
Plant Statistics. The experience of the Menasha utility resembles that of many others in its constant load growth. Since 1938 it has been necessary to purchase some power and in 1945 the total of purchased and generated power came to 14,402,793 kwhr, about twice the city's requirements of ten years ago.

Supt P E Widsteen is in charge of both electric and water utilities; William Riemer, who has been associated with the utility since 1909, has been chief engineer of the generating plant since 1925.



View of exhaust side of 60-cyl 1100-hp 300 rpm 4-cycle supercharged intercooled diesel at Menasha, Wisconsin, shows turbocharger and connection to the intercooler

Plant Proves Its Sound Design and High Efficiency in Changing Fuel Situation



General view of wood-preparation plant for Weyerhaeuser Timber Co, Everett, Wash., showing two slips for log handling

Efficient use of timber in the Northwest's forest-products mills is rapidly making woodwaste fuel scarce, and hydro power is available from the great dams. But operating experience shows that the steam-power plant is still as important as ever

By THOMAS W STEWART

Chief Engineer, Power Plant, Pulp Division, Weyerhaeuser Timber Co., Everett, Wash.

▶ IN THE SAWMILLS and in the pulp, paper and plywood mills of the Pacific Northwest the industrial steam-power plant still owes its importance despite changing conditions to the fact that requirements of process steam and of motive power go hand in hand. This relationship is practically constant for any particular type of plant or process. Therefore so far as we can foresee such forest-products plants will always generate a major portion of their own power.

Fuel Situation Changing. Moreover, it is increasingly important that the steam plant of such mills be well engineered and efficient because of the rapidly changing fuel situation. Costs are steadily increasing because wood-waste, formerly so abundant in the area, is becoming scarce. This results from new developments in the conservation and efficient utilization of timber by (1) better use of logs so there is less waste and (2) development of new markets for the waste material whose only use formerly was as fuel.

A striking example of experience with this changing fuel situation is that of the plant designed and erected by O C Schoenwerk in 1935-36 for the pulp division of Weyerhaeuser Timber Co in Everett, Wash. Operating experience has proved it soundly designed and efficient.

Process Requirements. Pulp making in a plant of the Everett type requires large amounts of steam and water, and processes are carried on at several levels of temperature and pressure, thus suggesting the use of higher initial steam-pressure and backpressure turbines. Three boilers supply 165,000 lb per hr of 630-psi 720-F steam to three turbine-generators, two of which are backpressure units. This steam-pressure level is higher than usual in pulp-mill operation.

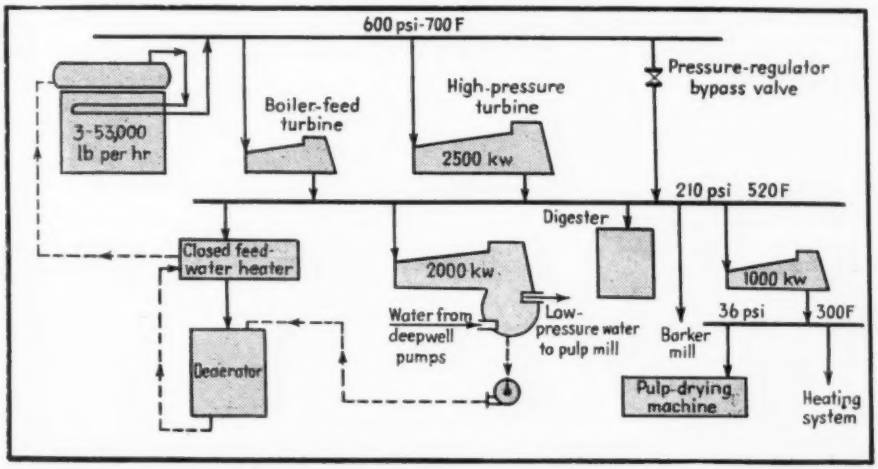
Space within the boiler room will permit a later addition of a fourth boiler. Air preheaters, forced- and induced-draft fans serve each of the present steam generators.

Turbine Equipment. The three turbine-generators mentioned above operate as follows. One, a 2500-kw backpressure unit, takes steam at 600 psi and exhausts to a steam trunk line at 210 psi. Remaining turbines receive their steam supply from this 210-psi line. The 1000-kw backpressure turbine exhausts directly to a pulp-drying machine at 36 psi. A second turbine that operates from this 210-psi line is a 2000-kw condensing unit. With the exception of a small high-pressure turbine that drives a boiler-feed pump, all power-plant auxiliaries and process-steam equipment throughout the mill draw steam from this 210-psi trunk line.

Maximum daily consumption of power

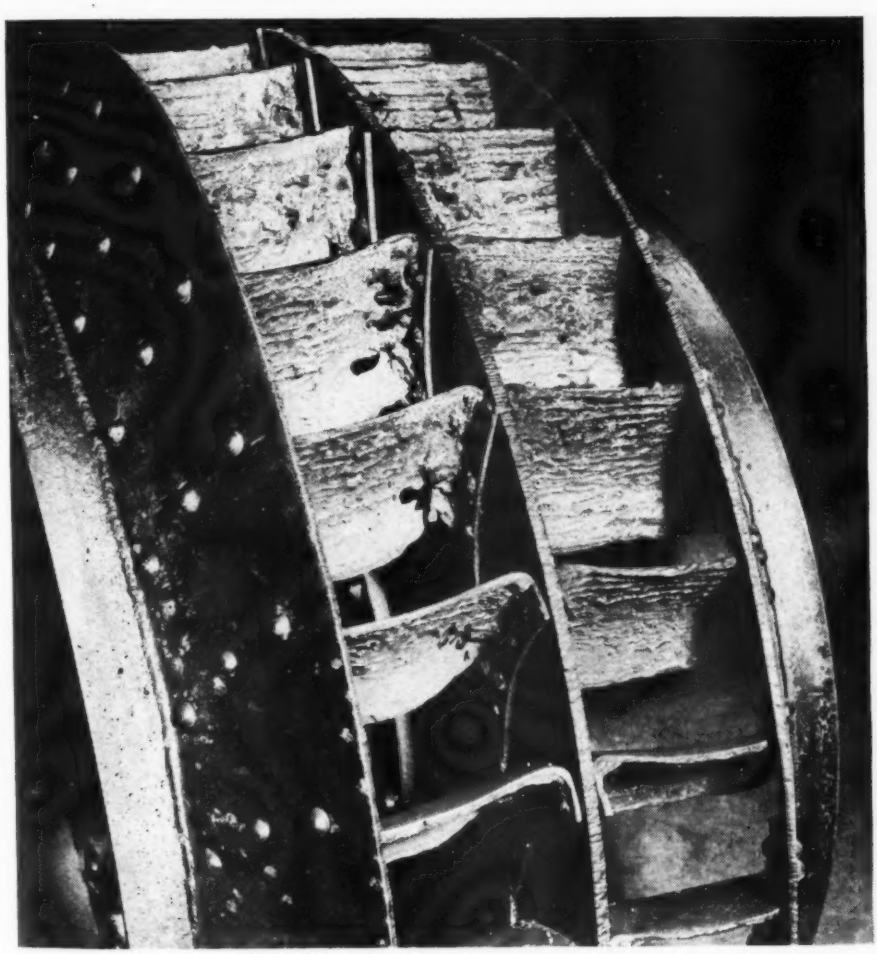
and process steam totals over 4,000,000 lb. Of the total power required for plant operation, 97% comes from the power plant and the remaining 3% is purchased. Plant turbines divide the load in this manner: the condensing unit generates about 30% and the two backpressure machines carry 70%. About 700 tons of fuel daily supply the heat needs for this steam and power generation.

Woodwaste and hogged refuse from mill operations originally met 75% of this total fuel requirement. The woodwaste portion of this supply, including bark, came from the process of preparing logs for chipping and subsequent pulping. Today woodwaste has been so reduced that only 20% of fuel needs are supplied from this source.



Flow diagram indicates various pressure levels of operation and major equipment drawing from them. Solid lines are steam headers and steam flow; dotted lines represent water cycle. The high-pressure mill water serves 2000-kw unit condenser

Debarking Improvement. This sharp reduction in woodwaste stems from replacing a combination of handwork and mechanical cutters with a hydraulic machine for debarking logs. To a large extent Weyerhaeuser pioneered and developed this hydraulic barker as a major step in the conservation and better utilization of wood. This machine uses two jets that deliver high-pressure water (1200 to 1400 psi) at the rate of 1000 gpm along a log placed horizontally. Log positioning is effected by a chain clamp that permits indexing after each horizontal pass of the jets so that all quadrants are exposed to the force of these jets. In less than 30 seconds this device removes bark from a log so completely that the log can be routed directly to the chipper without further preparation. Waste of valuable wood fiber, inevitable under the former method of repeated handlings, is consequently reduced. Sound pulpwood savings measure 20% over the previous figures when hand and mechanical cutters removed bark.



Fan blade demonstrates erosion from cinder in gas discharge. The wheel served 25 months under protective-welding program applied in position every five months

Logs enter by a conventional sawmill device into a wood preparation plant, which houses this hydraulic barker and a whole-log chipper. Slips permit raising logs from an adjacent pond to the operating floor of this wood-preparation plant. An additional slip allows return to this pond for storage if so desired.

Once logs reach the plant operating floor they are cut to a 26-ft maximum, if necessary, by a 120-in. circular cutoff saw, equipped with inserted teeth. From this point logs move under the control of an operator who, from his glass-walled booth, also directs the passage of the hydraulic-barker water-jet along the log. All log-handling controls operate from a hydraulic system.

BURNING WOODWASTE

Removed bark, with a small amount of chip screenings, moves by conveyor from the wood-preparation plant to the power plant. Water content of this portion of the boiler fuel (20% of the whole) is rather high—from 57 to 62%. The 80% purchased portion of boiler fuel, considerably drier, reduces the average water content of the fuel as fired to 50%. This aggregate fuel enters the boilers through a 2-cell dutch oven at each boiler front. Conventional firing procedure consists of directing the fuel from the loop-conveyor

fuel hopper through a dampered chute, manually controlled, onto fuel heaps that rest on tubular watercooled grates. Oil burners provide sufficient standby capacity to carry full load if so required.

Combustion Difficulties. Combustion of such water-laden fuel as described above carries inherent difficulties, among which are (1) salt deposits from the waters of Puget Sound and (2) cinder particles in the discharge gas.

To meet the first of these difficulties, salt deposits, a special design for waterwalls was developed. Because of this design, release of salt in the furnace proper presents no problems in this area but the salt does carry into the nest of superheater tubes where it forms deposits. Here an air lance, applied every day, removes these deposits, which ordinarily withstand action of a sootblower. Additional furnace maintenance consists of building up the exposed area of the grate surface by an arc-welding process about once every three years. After such treatment grates are run through plate rolls for straightening. The watercooled tubes of these grates need internal cleaning about every six months.

The second of these wood-combustion difficulties, cinders in the discharge gas, produces a highly abrasive action. Cinder load at Everett runs about one gr per cu ft of flue gas. Attempts to remove this cinder load by water-spray collectors fell short of the desired result and war prevented any change to different collectors. Accordingly maintenance measures were sought to combat the most serious erosion effects, those on induced-draft-fan blading. Blades of steel plate, ¼ in. thick, are often cut through in as short a time as 60 days. A number of protective measures were tried and proved ineffective at high loads. Best results to date come from arc-welding mild steel on fan-blade facings. At present even better results appear possible with cast iron similarly applied, but since only preliminary tests have been run this result has not been verified completely.

MAKEUP PROBLEMS

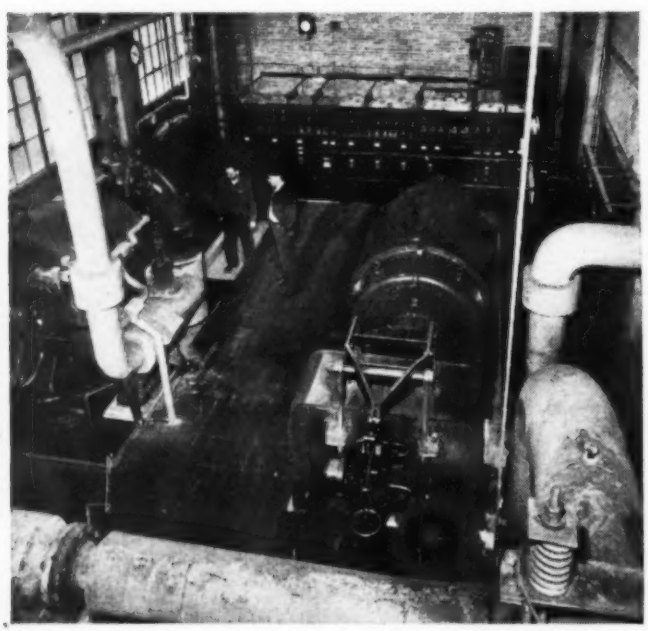
In addition to the combustion difficulties, the steam used in wood-pulp mills exacts its own operating problems. Chief of these, heavy-process-steam demands, results in a high makeup, some 60% at Everett. Raw water for makeup comes from adjacent stream-basin sources with a total solids content of 34 ppm, of which 4 to 14 ppm is silica.

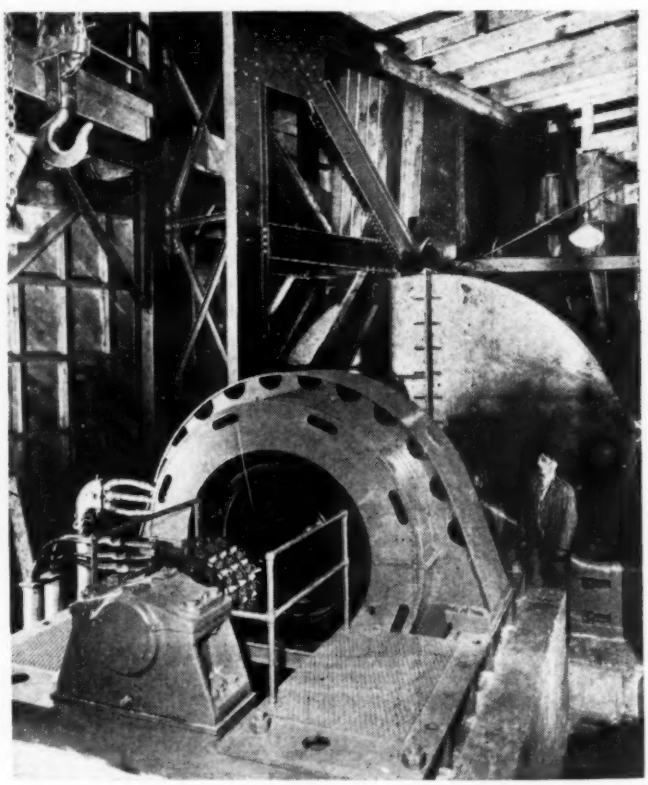
Accordingly, deposit of silica scale on turbine blades occurs continuously although no major outage has developed from this condition. Backpressure units do not accumulate a deposit heavy enough to make cleaning difficult. The condensing machine, however, constitutes something of a problem. Mechanical cleaning of this unit consumes too much time so recent trials with a caustic-solution method have been studied closely. To date, results seem good. An indication of the degree of success in clearing steam passage through the turbine is a change in first-stage steam pressure from 53 psi before washing to a reading after washing of 33 psi.

Water action within the boilers has left no evidence of marked scaling or corrosion of internal surfaces. However, in using internal water treatment it has been necessary under full-load conditions to open boilers about every four months to remove sludge from the feed drums.

Major Plant Auxiliaries. Boiler feed comes from two 6-stage centrifugal pumps. One, a high-pressure steam turbine, exhausts directly to the 210-psi steam trunk line. The second, an electric motor-driven pump, alternates with the steam unit as best fits the steam-electric balance. No serious pump trouble has been experienced. One wheel of the steam pump and one case wearing ring of the motor-driven pump have been renewed after nine years of service.

Water for condensing needs of the turbine-generator comes from a supply of filtered fresh water introduced through a high-pressure line and routed through the condenser on its way to the various process departments for their use. Condenser leakage presents no problem.





Above: Turbine-room view shows high-pressure unit and a low-pressure one. Right: Wound-rotor motor, 1000 hp, 235 rpm, direct connected, which drives a 171-in.-dia 10-in.-thick disk, which in turn reduces logs up to 40-in. dia and 26-ft. length to chips in 30 sec. This whole-log chipper in housing at rear carries four-48-in. steel knives

Vigilant Inspection Keeps Unfired Pressure Vessels Safe

Look for pits, cracks, defective welds, loose rivets and riveted joints sprung by expansion or rust, says W E Rossnagel, safety engineer. Be sure tank footing will carry the water load before making a hydrostatic-pressure test on an air or gas receiver

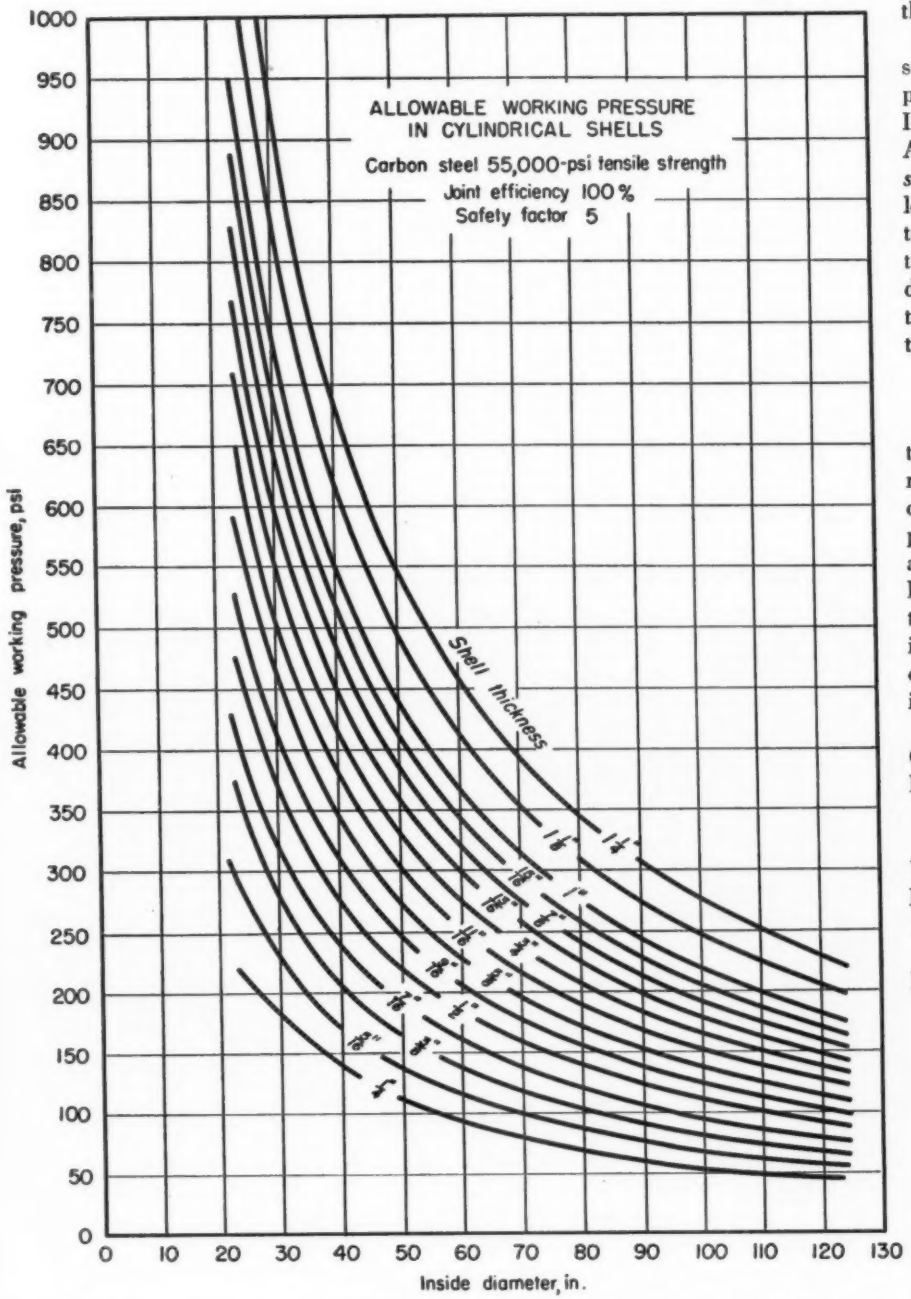


Fig. 1—These curves give the allowable working pressure of tanks made from carbon steel having a tensile strength of 55,000 psi, with joint efficiency of 100%

► UNFIRED PRESSURE VESSELS, like boilers, are reservoirs of potential energy. Enormous forces may be pent up in an innocent-looking container, such as the common 30-gal domestic hot-water tank. For instance, with water under 50-psi pressure, heated to just below the boiling point, some 2,000,000 ftlb of energy are available, ready to erupt violently should the tank rupture.

Before placing a pressure vessel in service make certain that actual working pressure does not exceed the design value. If a tank meets the requirements of the ASME *Code for Unfired Pressure Vessels*, it is stamped with the familiar 4-leaf clover and the design pressure and temperature. If it is not so identified and the data cannot be ascertained from the design drawing or from the manufacturer, measure the metal and calculate the strength of the vessel.

SAFE WORKING PRESSURE

In a welded tank, it is not always easy to measure the shell thickness. This may require drilling one or more holes and carefully calipering the metal at this point. If possible, inspect vessel inside and locate pitted areas. Then drill at least one such area and caliper the metal thickness. A special *keyhole* micrometer is well suited to this job as the holes can be closed with pipe plugs or by welding.

Refer to Paragraph U-20 of the ASME Code, to obtain the formula for calculating the allowable working pressure:

$$P = \frac{sEt}{R + 0.6\,t}$$

Where

P = allowable working pressure in psi

s = maximum allowable unit stress in psi

E = efficiency of longitudinal joint or of ligaments between rivet holes:

- (a) Calculate riveted-joint efficiency.
- (b) For seamless shell use 100%.
- (c) For U-68 welded joint use 90%.
- (d) For U-69 welded joint use 80%.

t = minimum thickness of shell, inches

R = inside radius of shell, inches.

Maximum allowable unit stress depends upon the grade of steel and operating temperature. It varies from 9600 to

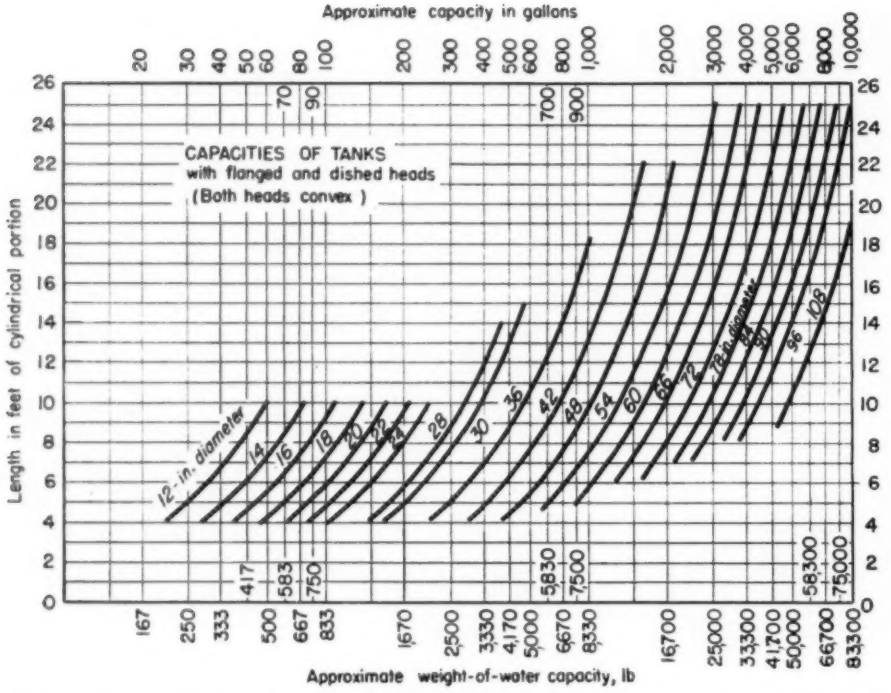

Approximate capacity in gallons
CAPACITIES OF TANKS
with flanged and dished heads
(Both heads convex)
Length in feet of cylindrical portion
Approximate weight-of-water capacity, lb

Fig. 2—Before making a hydrostatic test on a tank compute the water weight and be sure the tank supports, down to the final foundation, will sustain the load

11,000 psi for carbon-steel plates at temperatures up to 650 F, with reduced strengths at higher temperatures. If the vessel is properly designed, the convex or concave heads are as strong as the shell so it is only necessary to ascertain the shell strength. Curves in Fig. 1 serve for roughly estimating the safe working pressure of a vessel.

Continuing with assumption that the vessel is of questionable strength, apply a hydrostatic test before placing it in service and every year or so thereafter. At each subsequent test, make a thorough internal and external inspection. For the internal examination, purge tank properly and maintain good air circulation before entering it. Use a flashlight or work lamp. Have the latter adequately guarded; ground the lamp socket and guard to the tank electrically to avoid any possibility of shock to the inspector. Best practice is to use low-voltage equipment. Carefully observe entire outside and inside surfaces. Look for cracks, defective welds, loose rivets and scale, and riveted joints sprung out of shape from expansion or iron oxide. If tank passes visual inspection, prepare for the hydrostatic test.

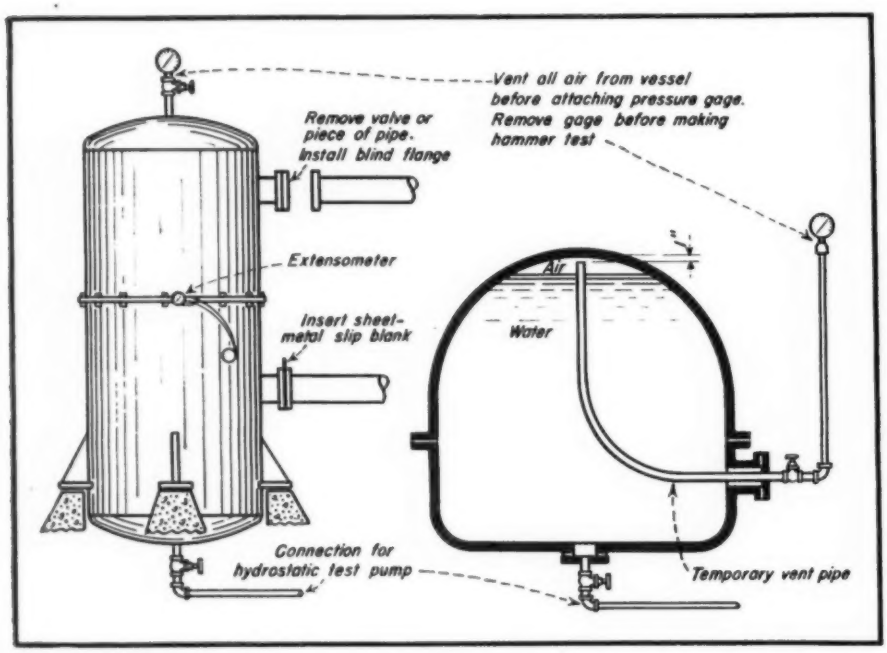

Vent all air from vessel before attaching pressure gage. Remove gage before making hammer test
Remove valve or piece of pipe. Install blind flange
Extensometer
Insert sheet-metal slip blank
Air
Water
Connection for hydrostatic test pump
Temporary vent pipe

Fig. 3—If the tank has no vent in the top, drill one or improvise a vent to release all air. If this is impossible, flush with CO_2, which water will absorb

PREPARE VESSEL FOR TEST

Before making this test take these preliminary steps: (1) Disconnect all piping from the tank and install blind flanges; slip blanks in place of gaskets, or pipe plugs. (2) Remove the pressure gage and safety valve, but not the gage glass, if so equipped. Plugging or blanking off all openings, as close as possible to the tank, and eliminating all valves, except on the filling pipe and vent, make it possible to detect yielding of the metal more readily; also there are fewer joints to leak and give trouble. Obtain a pressure gage, which has a dial range about four times the working pressure of the tank, and which has just been calibrated. Gage must be accurate.

Calculate weight of water for the test, Fig. 2, and check tank supports. The latter is most important because many air receivers are mounted on steel beams, for instance, whose strength is ample to support a tank full of air but may not support it full of water. If strength of supports is inadequate or questionable, shore them up before filling tank with water. Connect filling pipe to one of the tank's lower openings; provide a vent from uppermost part and install globe valves in both pipes as close as possible to the tank. Be sure to remove all air while tank fills with water. If it has no opening at the top, drill one or install an improvised vent, Fig. 3, to bleed off trapped air.

CO_2 DRIVES OUT AIR

If it is impracticable to vent the air as described, thoroughly purge the tank with CO_2 just before the water level reaches the uppermost opening in the vessel. The CO_2 drives out the air, and as filling continues the CO_2 dissolves in the water. Thus the tank can be completely filled with water without trapping a cushion of air or gas at the top.

When water flows out the vent pipe, attach the pressure gage and connect the hydrostatic pump in preparation for building up the pressure. While not absolutely necessary, it is desirable to attach an extensometer to the tank and record the stretch of the metal tank expansion as the pressure increases. This

device is a steel tape carrying a dial indicator, which is placed around the tank between girth seams, Fig. 3 and 4.

With the hydrostatic test pump, build up pressure to the working limit, and shut the inlet valve tightly. Watch the pressure gage. If there is no visible leak but the gage hand slowly drops back, it indicates that the inlet or vent-pipe valve is not tight or the tank is yielding (stretching). Make a notation on the test report indicating the readings on the pressure gage and extensometer. Also plot the point on a graph.

If the gage "stays put," open inlet valve and build up pressure about 10%, and let stand as before. Repeat at each increment of pressure (10%) until 150% of working pressure is reached. Shut inlet and pressure-gage valves and remove gage to avoid damaging it in making the hammer test. Strike the shell plates and heads at 6-in. intervals on both sides of each welded joint. Select a hammer whose weight—which should not exceed 10 lb—is about equal in pounds to plate thickness in tenths of an inch. Strike the plate with sharp, swinging blows. Test for loose rivets by striking the side of each rivet head with a ball-peen hammer while holding a ¾-in. steel washer against opposite side of the rivet head.

If there are no indications of leakage or other distress, replace the pressure gage and proceed to build up the pressure, an increment at a time, until double the working pressure is reached. Close inlet valve and thoroughly inspect all joints again. If pressure-gage pointer remains in one position for several minutes, the test is termed satisfactory.

RECORD DATA CAREFULLY

As previously mentioned, after each increment of pressure has been applied, the point is to be plotted on a graph having the pressure gage and extensometer readings as coordinates. These points should fall practically on a straight line. If the line suddenly begins to curve noticeably as a result of higher-than-usual stretch increments, it indicates that the elastic limit of the metal has been exceeded. In other words, the stretch is no longer proportionate to the pressure. When such a condition occurs, stop the pump immediately, and consider this part of the test completed. The safe working pressure should then be designated as one-half the pressure applied when the graph began to veer from a straight line. Likewise, if the pressure gage fails to stay put, it may also indicate the elastic limit has been exceeded. If the test is performed satisfactorily, then the safe working pressure may be accepted as being equal to the design or calculated working pressure.

Upon completion of the hydrostatic test slowly relieve the pressure by opening the inlet valve after disconnecting the pump. When the pressure gage reads zero, the extensometer should also read zero, or very near it, unless the elastic limit has been exceeded. But before emptying the tank do not overlook one important step, particularly on large low-pressure tanks. *Remove the vent pipe and leave the vent opening unobstructed.* Otherwise, when the water drains from the tank a partial vacuum will be created in the vessel. More than one large tank has collapsed because this precaution was not taken. And, incidentally, the water will drain out more quickly.

If an extensometer is not available, coat the tank, or at least parts of it, with thick whitewash which is allowed to dry thoroughly. If during the hydrostatic test the metal yields too much, the whitewash will crack and flake off. For further data on hydrostatic tests refer to ASME *Code for Unfired Pressure Vessels.*

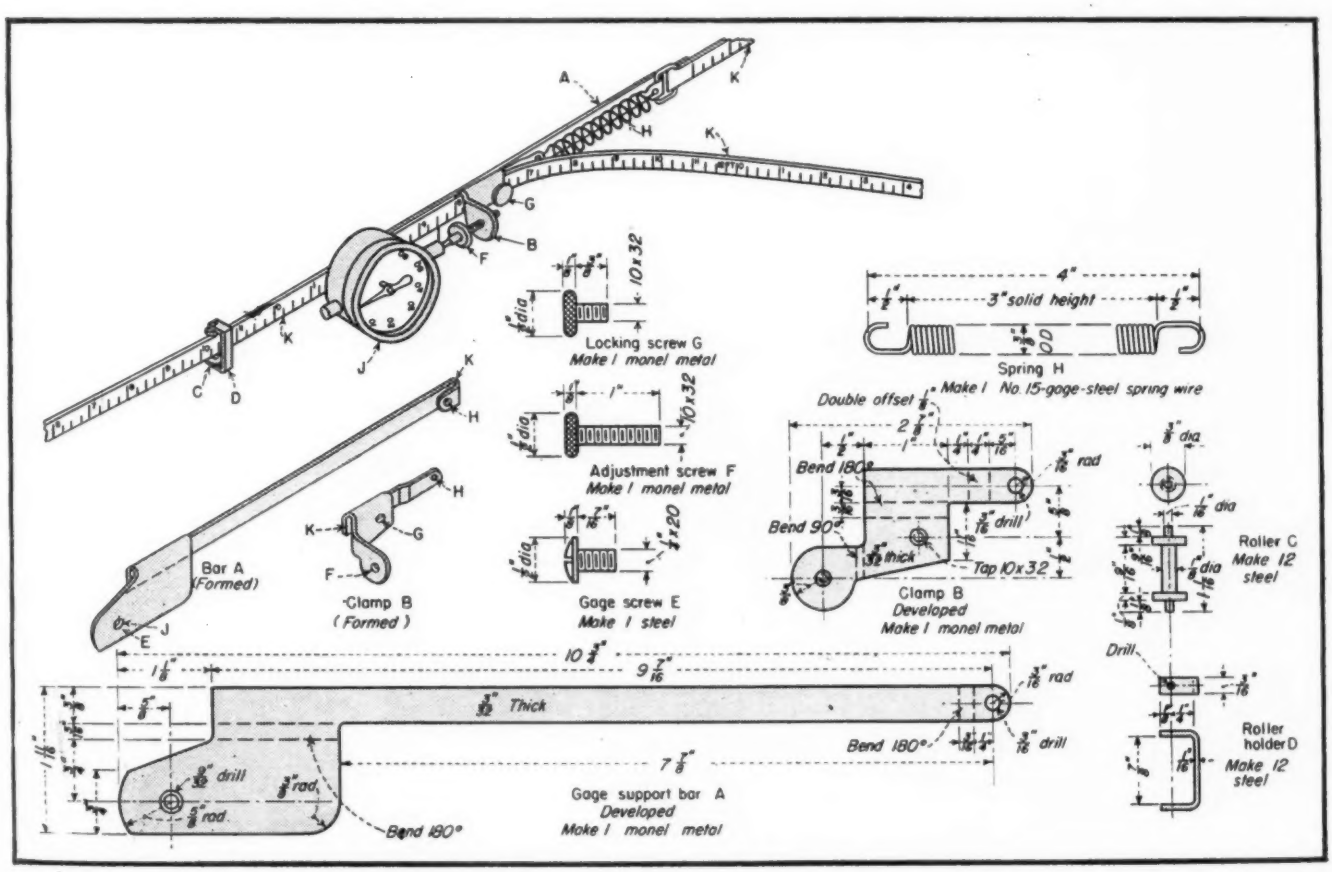


Fig. 4—An extensometer measures the amount of tank stretch as internal pressure increases during the hydrostatic test. Rollers and clamps can be made locally to fabricate the device from an ordinary steel tape and a machinist's dial indicator

National District Heating Association officers for the year 1946-7 (left to right) J F Malone, Cons Gas Elect Lt & Power Co, Baltimore, president; D W Loucks, Allegheny County Steam Heating Co., 3rd vice-president; H L Martin, Boston Edison Co, 2nd vice-president; and R D Martin, New York Steam Corporation, 1st vice-president

J F Collins Jr, secretary-treasurer and R M McQuitty, Union Electric Co of Missouri, retiring president, 1945-6, of NDHA discuss technical meeting plans

A R Mumford, Combustion Engineering Co, chairman of NDHA research committee, tells about methods used in the paper which he presented on "Furnace-Performance Study Instruments"

E W Feller, associate editor, POWER, and C A Hawk Jr, A M Byers Co., talk about some points in latter's paper, "Radiant Heating" given before NDHA

NDHA Resumes Annual Technical Meetings

National District Heating Association meeting features residential-heating load studies, radiant-heating applications, furnace-performance research, steam main and service construction difficulties, electric boilers, old boiler life extension

► THE 37TH ANNUAL MEETING of the National District Heating Association at the Cavalier Hotel in Virginia Beach, Va., marks the first full-scale meeting to be held by this group since 1942. With an attendance of about 150 this session becomes the second largest in the society's history.

In his annual address, President Roy M McQuitty, Union Electric Co of Missouri, emphasized the rapid increase of steam sales during the war years. Of 59 companies reporting, total annual sendout was over 47-billion lb in 1944 and over 48-billion lb in 1945. Steady load growth features the future prospects with many companies making provision for increased capacity and distribution facilities.

A report by James E Harris, Philadelphia Electric Co, chairman of the Insurance Committee stressed the advisability of increasing the value of coverage of insured properties to keep pace with the increasing costs of replacement in case of fire or damage.

In a paper, "The Bituminous Coal Industry Looks at District Heating," by W O Entenmann and W H Browne, both of Battelle Memorial Institute, the authors discussed some of the results of studies they are carrying on for Bituminous Coal Research, Inc to develop centralized heating for residential building groups.

RESIDENTIAL HEATING COSTS

Howard W Harrison, Georgia Power Co, in "Economics of District Heating for Housing Projects vs Private Plants" reported the comparative experiences of supplying steam to residential buildings of identical character when taken from district-heating steam mains not requiring extension and when supplied by a private central plant. Average unit steam cost from the utility system totaled 66.5c per 1000 lb, and from the private central plant 82.9c per 1000 lb.

Various installation methods and applications of radiant heating were discussed by C A Hawk Jr, A M Byers Co. Beside space heating applications, snow-melting installations on sidewalks, driveways and airport runways were cited. Ease of control and flexibility in use of heating fluid were reviewed. (POWER, May 1946, p 85.)

RESEARCH INSTRUMENTATION

In "Instrumentation for the Study of Furnace Performance", Research Committee Chairman A R Mumford, Combustion Engineering Co, told of the testing methods used by the ASME Committee on Furnace Performance Factors in pursuing their assignment. Several testing methods in simultaneous use permit their evaluation for selection in studying particular phases of operation. Over-all performance was the initial objective but the varying testing methods will enable studying performance in several furnace zones and making an estimate of the contribution to over-all performance.

Papers by J J O'Brien, N. Y. Steam Corp, and P Chenzoff, Philadelphia Electric Co, reviewed respectively difficulties of steam main and service installation in congested city areas, and methods and troubles experienced in trapping condensate from steam distribution mains.

"Steam Generation by Electric Energy," a paper by H C Mittendorf, Combustion Engineering Co, described some installations and designs of electrically heated steam boilers and indicated the most likely conditions under which they may be used economically.

A timely topic was the subject of a paper by R B Donworth, Allegheny County Steam Heating Co, entitled, "Extending the Useful Life of Older Boilers." He recounted experiences of rebuilding and redesigning boilers 40 years of age, which were found to have defective drums. Cost was less than one year's carrying charges of an equivalent new installation and the future life appears indefinite in length.

Does a Laundry Cut Costs by Buying or By Generating Its Electricity?

To find answer, determine how much steam goes to heating wash water, securing prices of new and used generating equipment; compare generation cost with that of purchased power

By J G BERGER, *Consulting Engineer*

► IN PRACTICALLY EVERY INSTANCE the advisability of installing generating equipment depends on the cost of purchased power and the amount of low-pressure steam needed for heating water. Fortunately it is fairly easy to set up comparison factors because where coal or oil costs are low, purchased power rates are usually comparatively lower than in high fuel-cost areas. Fuel costs affect a laundry plant, also, but the extra amount burned for power generation is a small percentage of that needed to produce process steam. On the other hand, cost factors set up for areas along the Eastern seaboard cannot be used to represent conditions farther inland and a chart similar to Fig. 1 must be made for each area.

Chart Compares Costs. Curves *A* and *B* indicate cost of purchased and generated power based on actual average laundry experience. Curve *A* covers both the energy and demand charge, and *B* includes all items such as operating costs and fixed charges—interest and depreciation. Crossing point of the two curves divides the chart into two areas: (1) uneconomical to install generating equipment (left of crossing point) and (2) economical. Dividing line falls at 25,000 lb of wash per week (bottom of chart) and for higher laundry outputs the curves separate to show considerable saving for generated power. Also listed, under work done per week, are kwhr used each month and corresponding bill and size of unit needed to carry the load on power-generating equipment.

Generating-Equipment Cost. Using a definite rate for fixed charges, curves *E* and *F* represent theoretical costs of generated power with used and new equipment respectively, and *D* compares them with the calculated purchased power cost, all based on good boiler efficiency. Results shown by curves *A* and *B* were obtained from average laundries whose predominating business is finished family work with small amounts of wet wash, dry cleaning and wholesale work. Capital investment costs differ from case to case because installed cost of new equipment varies to some extent and that of used machines quite widely in different localities. In general, a used engine- or turbine-generator unit may pay for itself in two or three years, whereas a new unit may require from four to eight years. But from the standpoint of longer life and higher efficiency, a unit of modern design offers a better long-pull investment.

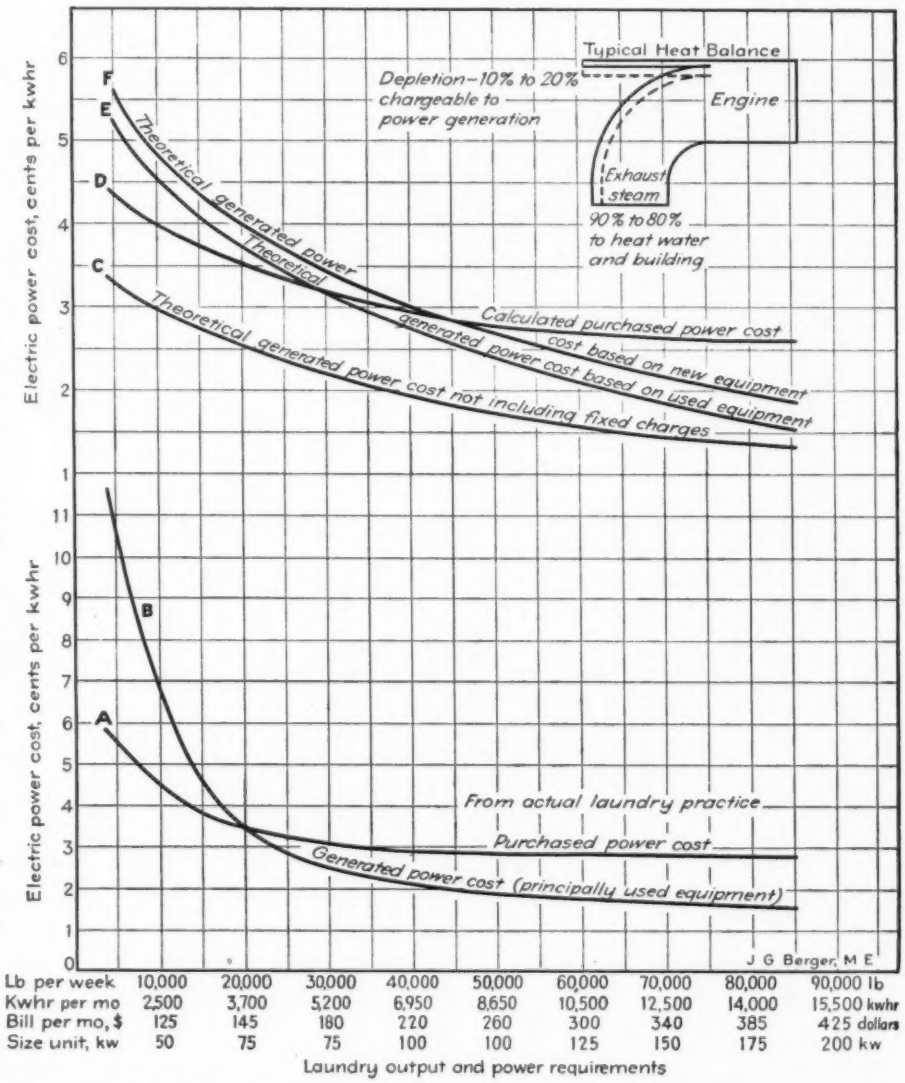

Typical Heat Balance
Depletion–10% to 20% chargeable to power generation
Engine
Exhaust steam
90% to 80% to heat water and building
F
E
D
C
B
A
Theoretical generated power
Theoretical
Calculated purchased power cost
generated power cost based on new equipment
cost based on used equipment
Theoretical generated power cost not including fixed charges
From actual laundry practice
Purchased power cost
Generated power cost (principally used equipment)
Electric power cost, cents per kwhr
J G Berger, M E
Lb per week 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000 lb
Kwhr per mo 2,500 3,700 5,200 6,950 8,650 10,500 12,500 14,000 15,500 kwhr
Bill per mo, $ 125 145 180 220 260 300 340 385 425 dollars
Size unit, kw 50 75 75 100 100 125 150 175 200 kw
Laundry output and power requirements

Fig. 1—Cost factors compiled for one area are not necessarily correct for other localities. Studies of the equipment costs and power rates must fit the plant

Assume a laundry purchases 6950 kwhr per month to do 40,000 lb of work per week. How much would a *used* 100-kw engine-generator save? Curves *A* and *B* indicate a saving of 0.75c, and curves *D* and *E*, 0.15c. Suppose we average the two results and get 0.45c. Then the yearly saving is 0.0045x6950x12 =

$375.30. Going a step farther and investigating a *new* unit shows that the higher fixed charges, curves *D* and *E*, make generating cost higher than that of purchased power for this particular plant. When the business increases beyond 50,000 lb per week consider new units.

Suppose the comparison is based on operating costs only, the investment being financed 100% and paid off out of gross savings. Taking credit for fixed charges, curve *C* shows a reduction of 1c per kwhr, or a yearly saving of .01x6950x12 = $834.00, instead of $375.30. (Curves *A* and *B* are based on actual experience with used equipment, and savings indicated by them cannot be included in the average when considering new units.

A chart of this nature makes it easy to figure the economy of installing a generating unit to carry the electrical load by using 10 to 20% of the heat in the steam and exhausting the remainder to heat water for the washroom. Arrangement is ideal when power load and exhaust-steam requirements just match; next best situation is when electrical load is lightest and a small amount of high-pressure steam is required to make up exhaust deficiency. But when electrical load predominates, more exhaust steam is produced than needed and the surplus goes to waste. This not only wastes heat, but means more outlay for makeup-water treatment. Here the answer may be an internal-combustion-engine-driven generator to carry the peaks, letting the steam unit operate on base load as exhaust requirements dictate. The former machine then operates on clean-up days and shutdown periods.

STEP-UP PLANT EFFICIENCY

With an eye to increasing plant efficiency before investigating the economies of generating electricity, it is advisable to double-check boiler performance, plant heat balance and method of firing. First step in good plant operation is to keep adequate records not only to uncover bad practices, but also to get a picture of past performance and future cost trends. For instance, decisions made one year on buying fuel may have to be reversed the next if operating costs are to be kept down.

To obtain records and keep the operating force on their toes the plant must have instruments that show what is going on. They testify against the fireman who lets holes develop in the fire bed, cleans the tubes only when they are so dirty that even he notices the draft is poor, and does not bother to stop air leaks in the setting. Such plants may show a boiler efficiency under 50%.

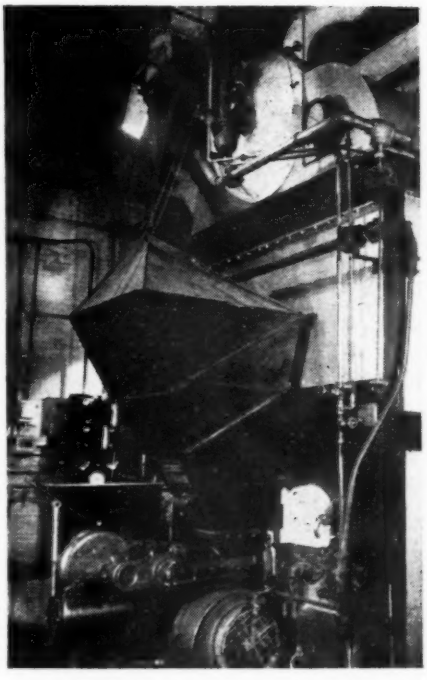


Fig. 2—Suitable automatic combustion control in conjunction with stokers, pulverized coal, oil or gas should receive consideration before hand firing

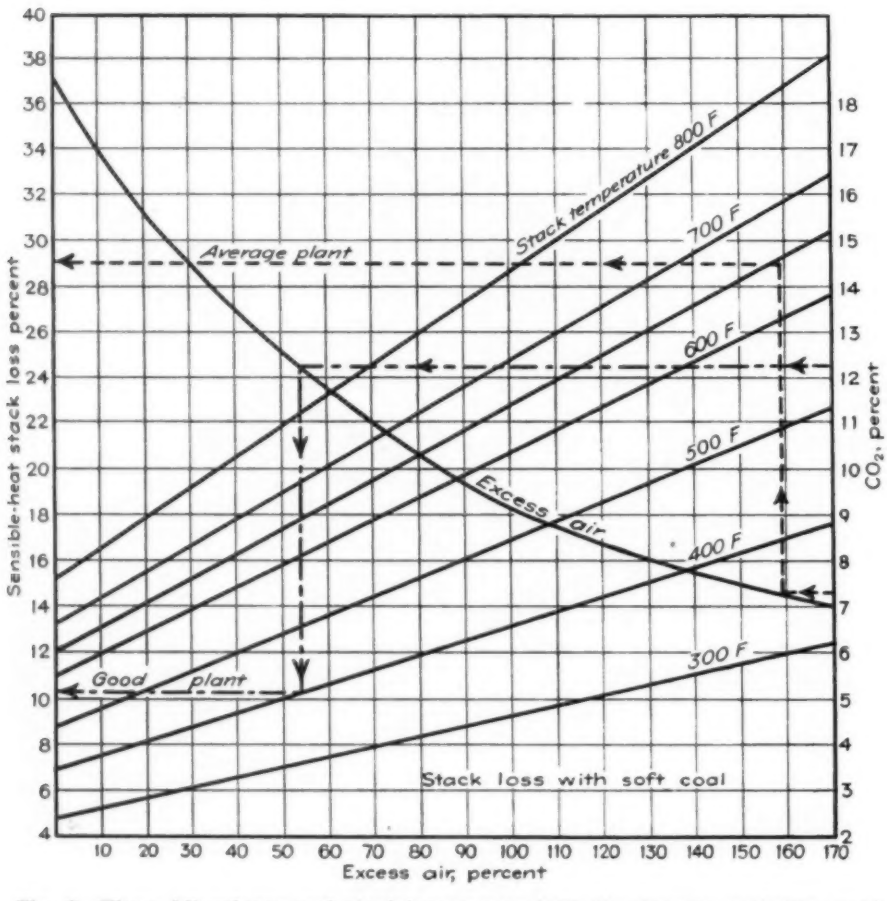


Fig. 3—These bituminous-coal stack-loss curves help the fireman maintain good boiler effciency if he is provided with a CO_2 and flue-gas-temperature recorder

Consider the value of recording instruments for CO_2, flue-gas temperature, steam pressure and feedwater temperature, together with draft gages. Suppose CO_2 is 7% and flue-gas temperature 650 F. Fig. 3 shows these conditions result in a 29% heat loss up the stack. Improvements that raise the CO_2 to 12.2% and drop the flue gas to 400 F reduce stack loss to 10%. With a yearly fuel bill of $10,000, this 19% reduction in waste saves $1900.

Plant Heat Balance. Charts such as Fig. 4 for coal and Fig. 5 for oil, show how flue-gas temperature and CO_2 affect boiler efficiency. Suppose the plant meters indicate a falling steam pressure, CO_2 of 8%, and flue-gas temperature 700 F. Using Fig. 4 shows a boiler efficiency of about 66% that might easily be raised to 78% by cleaning the heat-transfer surfaces (scale and soot) and improving combustion so that flue-gas temperature drops to 550 F and CO_2 content increases to 12%. Coal usage then drops $\frac{78 - 66}{66} = .18$, or 18%. Again, if the CO_2 content and draft pressures are correct but flue-gas temperature high, a badly scaled boiler is indicated.

Method of Firing. Boiler efficiency also depends to a considerable extent on

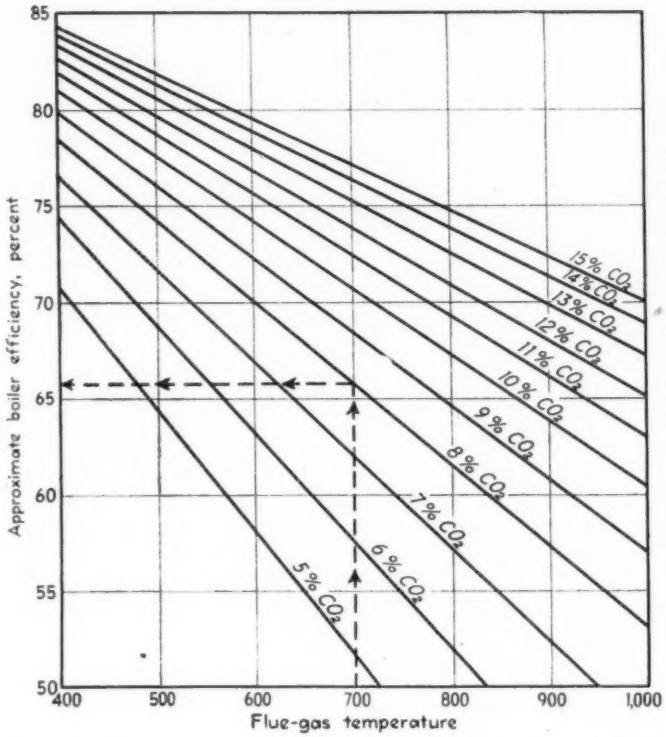


Fig. 4—Bituminous-coal boiler-efficiency chart: 14,000 Btu, 77.14% carbon, 5.2% hydrogen, 2.6% moisture, 34.% volatile, 6.1% ash. No CO in flue gas; room air is 80 F

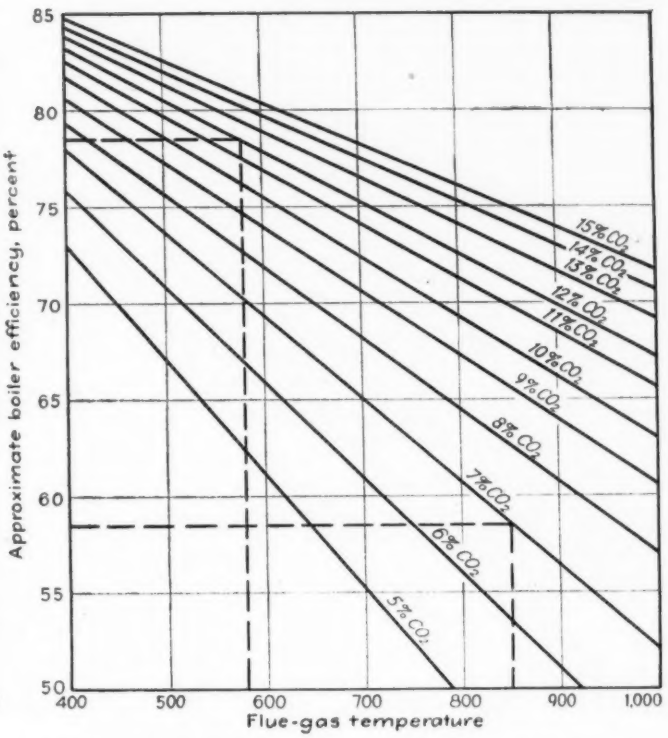


Fig. 5—Fuel-oil boiler-efficiency chart: bunker C No. 6 heating value 150,500 Btu per gal, 87.2% carbon; 10.3% hydrogen, 2.4% moisture. No CO in flue gas; room air 80 F

the method of firing. Suitable automatic combustion control, working in conjunction with stokers, pulverized fuel or oil, should always be considered in preference to hand firing. Uniform fuel and air feed regulated according to the load keeps the boiler operating at best efficiency throughout the load range. Once boiler efficiency is known, it is easy to keep track of steam cost with the chart, Fig. 6. Producing steam efficiently is one step in improving plant performance; second is to cut down loss and eliminate waste in the laundry itself.

Consider radiation loss from an uninsulated steam line in the finishing room or other overheated area. The room is always many degrees cooler than the steam pipe and, in fact, radiation loss may be only 25% lower than it would be if the pipe were installed outdoors. A bare 3-in. pipe one foot long may, under some conditions, waste 500 lb of coal a year. Based on $6 coal, this amounts to $1.50 a year, whereas the cost of insulating the pipe is about 50c.

Condensate return lines from various traps also waste heat unless they are insulated. Steam and condensate lines are installed to serve the process load and not to heat the building. Use conventional heaters for this. Best results are obtained if the condensate goes back to the boiler without flash or heat loss unless they serve a useful purpose.

Dumping wash water of 120 or 140 F to the sewer without first running it through a heat reclaimer is an inexcusable waste. Fresh process water passing through the heat reclaimer on its way to the heater or boiler makeup can be warmed 25 or 40 F by heat absorbed from waste water. Purpose of the heat reclaimer will be partly defeated if cold rinse water is not bypassed. One installation costing $2500 saves $640 each year, actual laundry practice during normal operation.

A large expense item in a laundry is the water bill. It usually pays to investigate the possibility of securing water from a well especially if the municipal supply has a high hardness content. In one instance an outlay of $3000, the cost of drilling a well and installing pumping equipment, saved an average of $1000 yearly in the cost of water and the necessary treating materials..

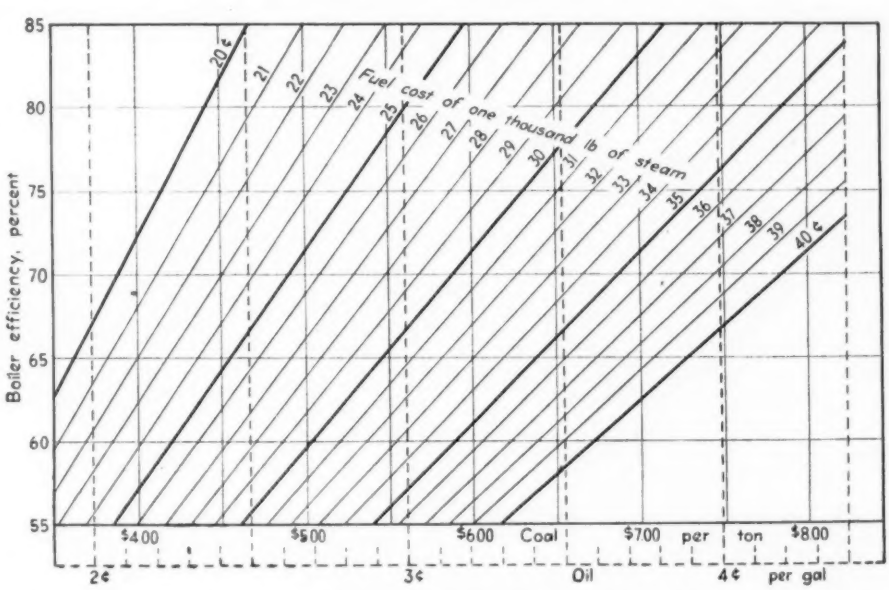


Fig. 6—Curves for steam cost per 1000 lb are based on 14,000-Btu-per-lb coal and 150,000-Btu-per-gal oil. Steam is 105 psi, moisture 2%, and feedwater 205 F

SHORT CUTS TO PLANT EFFICIENCY

By W A SHOUDY

No. 5—How Large a Furnace?

In this practical series based on fundamentals, experience and common sense, a consulting engineer shows how to design an economical plant for process steam and power. No. 4 of this series appeared in the May issue of POWER.

► DIMENSIONS OF A BOILER FURNACE are determined by two factors: For stoker- and hand-fired units (1) grate surface and (2) furnace volume. For pulverized coal, oil or gas (1) flame length and (2) furnace volume.

For the final furnace design much skill and experience are required in the consideration of these factors because characteristics of the many firing systems differ widely. However it is possible to point out a few basic factors that result in a safe furnace. Cost increase of a conservatively designed furnace over one just big enough is so small that the greater refinements are necessary only in large units or limited space.

Space Proves an Aid. Don't be afraid of ample space. It costs little and saves much in labor for inspection and maintenance. An ample boilerhouse building costs less per cubic foot than a crowded one. Cost of machinery foundations, supports and coal bunkers is the same whether space is crowded or ample. An additional foot of building length does not increase the cost proportionately. It adds a foot to length of roof, floor and two walls. But there is no change in scaffolding cost. Neither is the weight of columns changed appreciably nor that of floor beams or purlins. However, a crowded furnace may prevent carrying the load when poor coal arrives.

The function of a boiler furnace is to deliver to the boiler surfaces the products of combustion completely consumed, with no CO and a minimum of excess air, and with the gas as clean as possible. We need, as E G Bailey has said, "Time, temperature and turbulence." We get time from furnace volume, temperature by limiting excess air, and turbulence by forced draft and by burner or stoker design. If we run short on one we must increase the others.

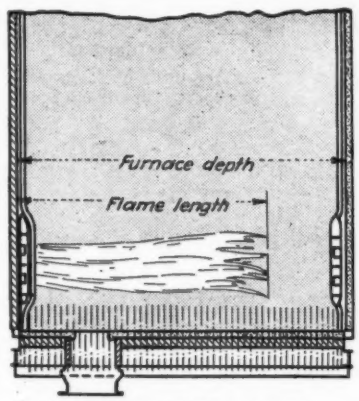
Since the purchaser does not design the burner or stoker he must accept the best turbulence he can get and suit the time and temperature to it.

Provide Enough Time. Time is a function of total floor length (often longer than visible flame length). The old rule, *never let the flame lap the tubes,* was good because hydrocarbons were not chilled and smoke was prevented. But the invisible flame lapped the tubes; CO at the end of the flame was chilled, and if it burned to CO_2 at all, it did so in the first or second pass. There it burned the superheater supports or remelted the flyash and slagged up the gas passages. Safe flame length can be checked only by a gas analysis showing no CO or unburned hydrocarbons.

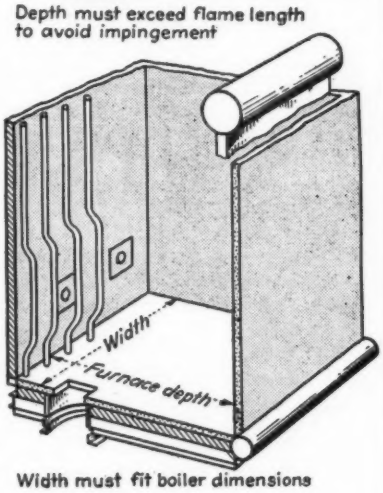
Flame length of hand- or stoker-fired units is relatively short because much combustion occurs on the grates. Pulverized-coal flames are the longest because all combustion is in suspension and time is necessary to burn the coal particles. Oil and gas particles are many times smaller than pulverized coal; hence their flames are shorter.

The Factor of Turbulence. Turbulence decreases these flame lengths: (1) with stokers, furnace shape (as with anthracite) or steam or air jets do the trick, (2) with pulverized coal, oil and gas, turbulent burners do it. For good combustion, furnace size is not determined by Btu liberated per cubic foot but by turbulence. In the investigations on burning anthracite (*Transactions ASME,* Vol 46, 1924, p 639) reducing the furnace volume raised efficiency about 5% and in so doing made it the right shape. Unfortunately it is difficult to maintain an irregularly shaped furnace; hence we are restricted to generally rectangular

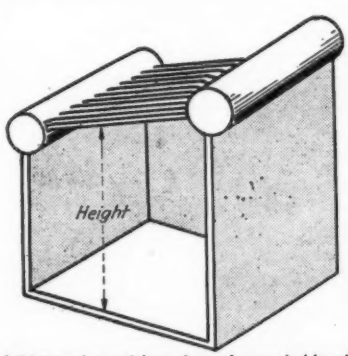
Inside furnace view of an underfeed stoker shows that the individual retort width directly affects the total furnace width. Ladders indicate general dimensions



Depth must exceed flame length to avoid impingement



Width must fit boiler dimensions



Height must provide volume for needed heat release

Dimension-by-dimension development of horizontal-fired pulverized-coal furnace. Dominant factor influencing each dimension is given below individual cut

furnaces with an occasional watercooled arch where it can be tied into the boiler circulation, except where irregular shape is considered necessary, as for anthracite, wood, bagasse, etc.

FUEL SUPPLY A MUST

First step in designing a boiler furnace is to estimate the maximum fuel weight that must be burned continuously for the entire plant. This figure divided by the minimum number of boiler units available gives the individual furnace load. If stokers are used we must pick a conservative maximum continuous rate of combustion per sq ft of grate. With multiple-retort stokers we can estimate a width and length. Remember that widths vary by the number of retorts in steps of 21 in., and lengths from about 1 ft up to 21 ft, also that the cost is slightly lower and fire conditions a little better with a multiple-retort stoker slightly longer than it is wide.

If a spreader stoker is used the plan may be square and the dimensions increase in steps of one foot. In small sizes, the single-retort furnace is generally square or wider than it is long. Its length increases in steps of 1 to about 10 ft maximum. Size of the side-dump plates can be selected so the stoker width will fit the boiler. Traveling-grate stokers vary in steps of about one foot and should be longer than they are wide. By this means we can determine the horizontal length and breadth of the furnace bottom.

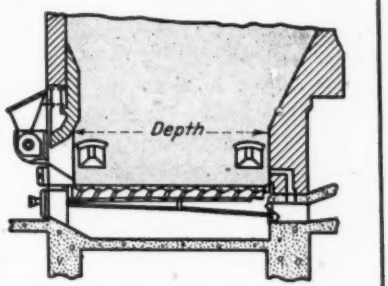
PULVERIZED-COAL CASE

Now for our next case. If pulverized coal, oil or gas is used we must learn the flame length at maximum load for the burner under consideration. Since most burners are set to give a horizontal flame, flame length determines the minimum depth of the furnace. For pulverized coal suitable length may be taken as 12 ft, and for oil or gas with turbulent burners 10 ft. Minimum furnace width is that necessary to accommodate the required number of burners.

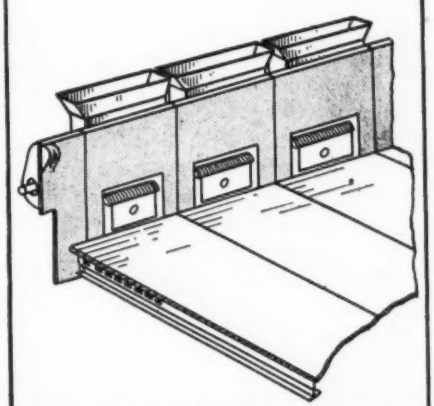
A pulverized-coal or oil furnace is generally in a state of rather complete turbulence with little short circuiting of gases. The furnace volume is therefore a reasonable indication of the degree of completion of combustion, but this is not necessarily true of a stoker furnace. Unless turbulence is increased by the furnace shape, or by air or steam jets, the flame leaving the stoker bed may take the shortest possible path to the chimney, and streams high in free oxygen may travel beside streams of CO without mixing. These separate streams continue through the boiler and economizer, and an increase in furnace volume does very little more mixing.

If coal is a poor grade, more is burned and the gas weight increased. Mixing of air and fuel may not be so good, requiring still more air: Gas-volume increase thus increases the gas velocity. This higher velocity carries the combustion and flyash into the first pass, which may choke with slag.

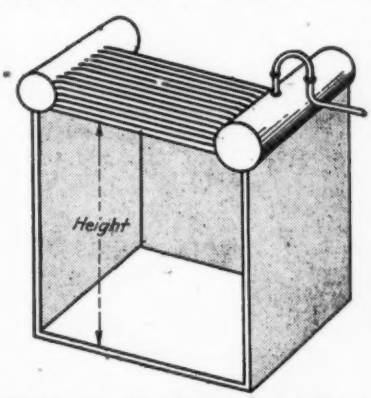
Rating of Furnaces. Unfortunately there are few published data on flame length that can be stated in simple formulas. We do the next best thing—rate our furnaces in Btu released per cu ft per hr and try to visualize the gas travel, modifying the furnace accordingly. A fair average for stokers would be 50,000 Btu per cu ft per hr maximum for low-volatile coals and 40,000 for high-volatile coals. These rates have often been exceeded. Good combustion can be obtained with pulverized coal at 20,000 to 26,000 Btu per cu ft per hr, and oil at 60,000 to 80,000 Btu per cu ft per hr.



Depth can't exceed spreader stoker throw



Width must meet required grate area with proviso that it equals an even multiple of unit stokers



Height must provide volume for needed heat release

Spreader stoker-fired furnace with chief requirement each of its three dimensions must meet shown as each requirement influences the design step by step

These rates apply to combustion efficiency and not furnace maintenance.

We now have sufficient information to determine furnace dimensions. Next step is to fit a boiler to the furnace, but first let us consider furnace maintenance.

Brick for coal-fired boiler furnaces should be of first quality, free from spalling with a minimum coefficient of expansion. If properly laid it fails for only two reasons: being broken away by breaking off attached clinkers, or eroding by fusion with molten ash. Oil-fired settings fail because of high temperatures or unequal expansion. Brick-softening temperature should be higher for stokers, with a minimum expansion coefficient. If the boiler is small it may be difficult to design a small furnace. Refractory setting may be used if the heat release for short periods does not exceed (1) 20,000 Btu per cu ft per hr with a high-fusing-temperature ash or (2) 16,000 Btu per cu ft per hr with fusing temperature below 2300 F.

Watercooled furnace walls somewhat reduce the required area of the other boiler surface; hence cost of the boiler and setting is about the same whether the setting is or is not equipped with waterwalls. They are now becoming almost standard equipment. Their failure is no more frequent than that of other tubes of a boiler.

TABLE HELPS SELECTION

With coals containing about 10% ash, fusing temperature no lower than 2300 F, we may burn coal at the rate, per sq ft of grate surface, given in the accompanying table. These rates have been exceeded, but they represent a conservative figure for selecting stoker sizes.

As an example let us select a multiple-retort stoker for a boiler and economizer to carry a maximum load of 100,000 lb per hr. Steam pressure 400 psi, temperature 650 F. Feedwater temperature entering economizer 200 F. Factor of evaporation 1.21, efficiency 82%. Coal 14,000 Btu per lb. Actual evaporation of coal 9.82. Maximum lb coal per hr 10,200.

$$\text{Grate surface } \frac{10,200}{45 \text{ lb/sq ft}} = 226 \text{ sq ft}$$

$$\text{Try 9 retorts } 9 \times \frac{21}{12} = 15.8 \text{ ft wide}$$

$$\frac{226}{15.8} = 14.3 \text{ ft long, nearly square}$$

$$\text{Try 8 retorts: } 8 \times \frac{21}{12} = 14.0 \text{ ft wide}$$

$$\frac{226}{14} = 16.2 \text{ ft long}$$

The above is OK.

Try 13,000-Btu coal, total coal 11,000 lb per hr:

$$\frac{11,000}{226} = 48.7 \text{ lb per sq ft grate, per hr}$$

A little small for bad coal.

Try 8 retorts, 17 ft long, 238 sq ft

$$\frac{11,000}{238} = 46.2 \text{ lb per sq ft grate, per hr}$$

The above can get by.

With regular coal:

$$\frac{10,200}{238} = 42.9 \text{ lb per sq ft}$$

This is satisfactory.

Normal load 70,000 lb steam per hr at 84% efficiency.

Coal 6890 lb per hr:

$$\frac{6890}{238} = 28.9 \text{ lb coal per sq ft grate, per hr}$$

The above is satisfactory.

We may, therefore, select an 8-retort stoker as near 17-ft length as the manufacturer can furnish from his standards.

Try 40,000 Btu per cu ft of furnace volume, horizontal area 238 sq ft:

$$\frac{10,200 \times 14,000}{40,000} = 3570 \text{ cu ft volume furnace required}$$

$$\frac{3570}{238} = 15 \text{ ft high}$$

This height will probably be exceeded by the boiler, and the furnace volume will be increased, giving a very conservative furnace.

It might be well to extend the stoker under the boiler mud drum and install a watercooled arch. This may cut the depth of the clear furnace height by 6 or 8 ft, giving a horizontal area of

$(17\text{-}6) \times 14 = 154$ sq ft

$\frac{3570}{154} = 23$ ft, 2 in. *This is reasonable.*

To accommodate the rear arch the mud drum should be at least 10 ft above the stoker floor. The vertical-drum centers should not be less than 16 ft, giving $10+16 = 26$ ft for furnace height.

The type of boiler and drum centers will be discussed in another article.

RATE FOR BURNING COAL PER SQUARE FOOT OF GRATE SURFACE

For coals containing about 10% ash whose fusing temperature is no lower than 2300 F

	Normal	*Maximum continuous*
Hand-fired grate	18 lb/hr	35 lb/hr
Single-retort side-dump stoker		
6 x 6 ft and smaller	20	25
Larger than 6 x 6 ft	25	40
Multiple-retort stoker	35	45
Spreader stoker	35	50
Traveling-grate stoker, anthracite		
Buckwheat No. 3	30	40
Buckwheat No. 4	25	35

Oxygen Disappearance

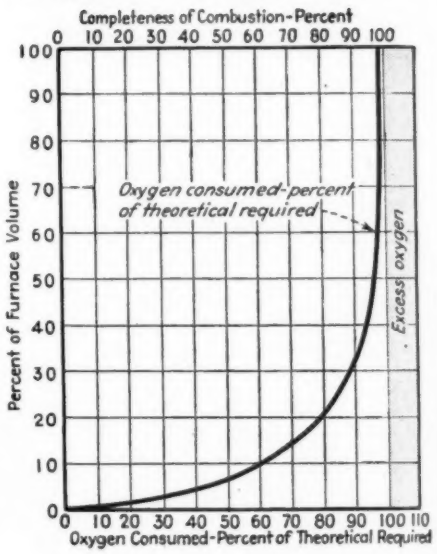
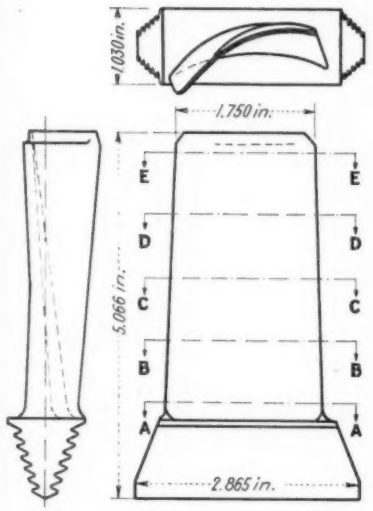
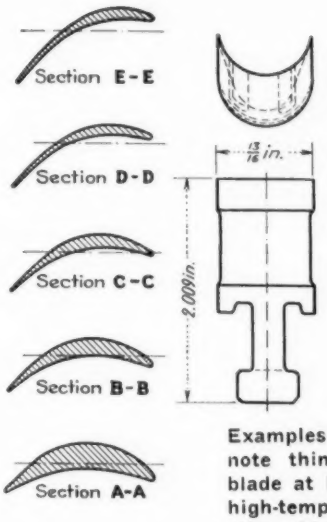

Completeness of Combustion-Percent
0 10 20 30 40 50 60 70 80 90 100
Percent of Furnace Volume
100 90 80 70 60 50 40 30 20 10 0
Oxygen consumed-percent of theoretical required
Excess oxygen
0 10 20 30 40 50 60 70 80 90 100 110
Oxygen Consumed-Percent of Theoretical Required

Chart (courtesy, Combustion Engineering Co) is a means of determining combustion rate of pulverized fuel within a furnace by charting disappearance rate of free oxygen. For a 98-99% complete combustion, oxygen disappearance follows curve to give an oxygen content of furnace atmosphere of about 2% by volume at its outlet. Note combustion is over 95% complete in first 50% of furnace volume.

If ordinates, depicting percent furnace volume along flame path, represent equal intervals of time, and this same relation holds for the abscissae, percent oxygen consumed, then slope of curve at any point is time rate of oxygen disappearance or combustion rate at that point. With this as a measuring device, nominal heat release in Btu per cu ft, multiplied by percent oxygen consumed and divided by percent furnace volume traversed, gives rate within that part of furnace.

Machine Parts Exactly Made By Precision Casting



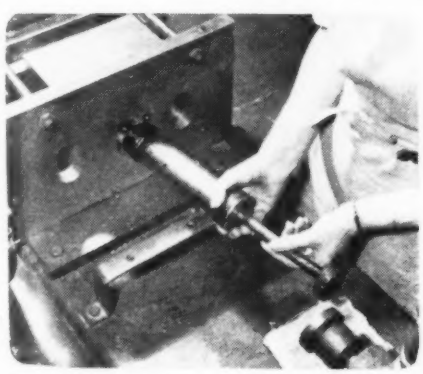


Examples of cast turbine blades; note thin edges and warp of blade at left. Middle blade for high-temperature steam turbine, other blades for gas turbines

Mass production methods, derived from precision dental casting process, are used to make aircraft-supercharger-turbine blades and mechanical parts difficult to machine or to forge. Here's the story of Haynes Stellite Co manufacturing methods

1 Master pattern may be made from brass, steel, alloy, wood, etc.; it is slightly oversize to allow for shrinkage. Here pattern is checked

2 From master pattern, die castings are made. These dies are used to mass-produce any number of wax patterns duplicating the master

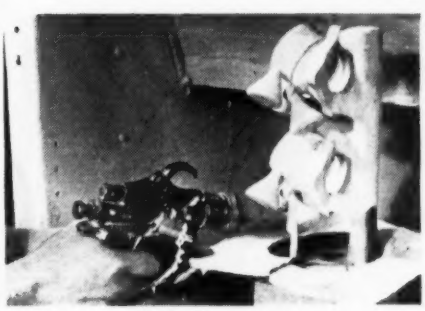


3 Die assembled with necessary cores has the wax injected from a "gun" operated by means of pneumatic ram located at the lower right

4 Wax pattern is removed from die. Wax that accumulates in opening through which it is injected (gate) is removed by manual breaking off

5 Two wax patterns being mounted on main gate made of wax to provide channels through which casting metal will be poured in mold

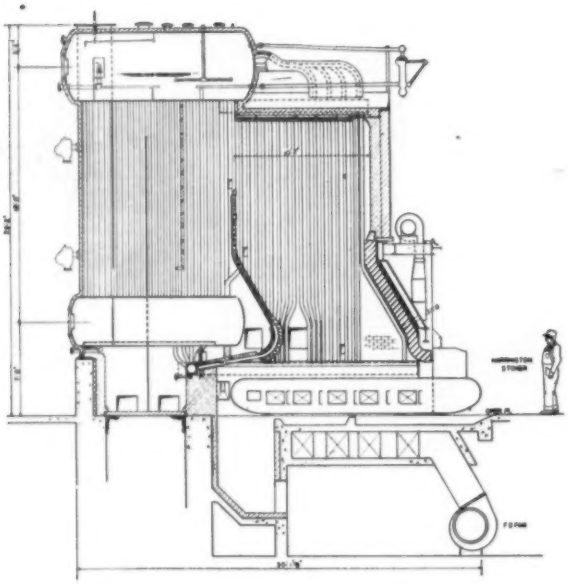
6 Dipping of assembly into fine silica solution provides surface in mold that insures a smooth finish for surface of final metal casting



7 After dipping, end of wax assembly is mounted on square steel base; uncoated surfaces are sprayed with silica; assembly then dehumidified

PRECISION CASTING continued on page 98

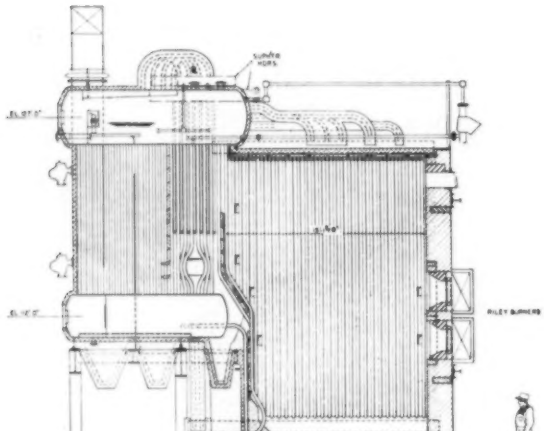
Typical Recent Riley Steam



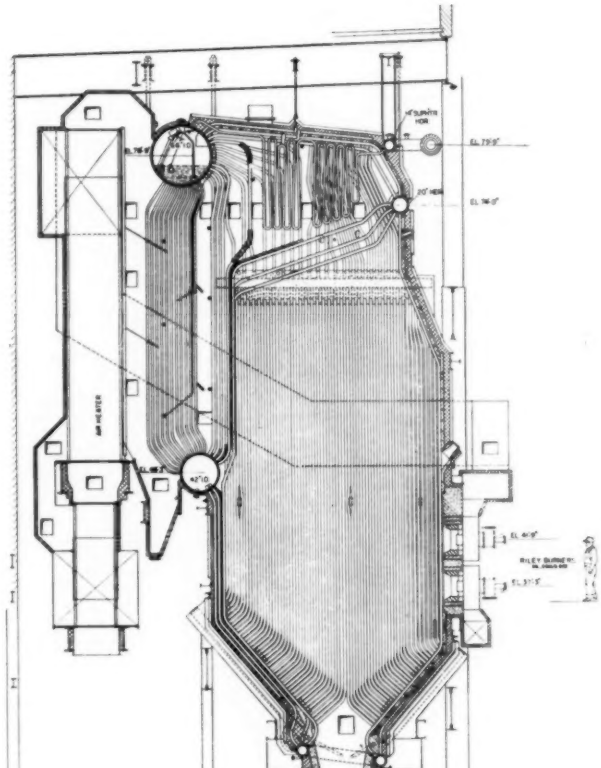
Industrial Rayon Corp., Cleveland, Ohio
55,000 lbs./hr.—180 lbs.—Saturated
Efficiency 77.7%
Harrington Traveling Grate Stoker Fired

These are the types of Steam Generating Units being installed today in so many of the country's leading industrial power plants.

A modern steam generating unit must not only operate at high efficiency but must give long continuous trouble free operation with low maintenance.



Owens-Corning Fiberglas Co., Newark, Ohio
40,000 lbs. /hr.—270 lbs.—600°F.
Efficiency 83.5%—Pulverized Coal Fired



Large Eastern Oil Refining Co.
300,000 lbs./hr.—750 lbs.—750°F.
Efficiency 86%—Oil Fired
Future Pulverized Coal Firing

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

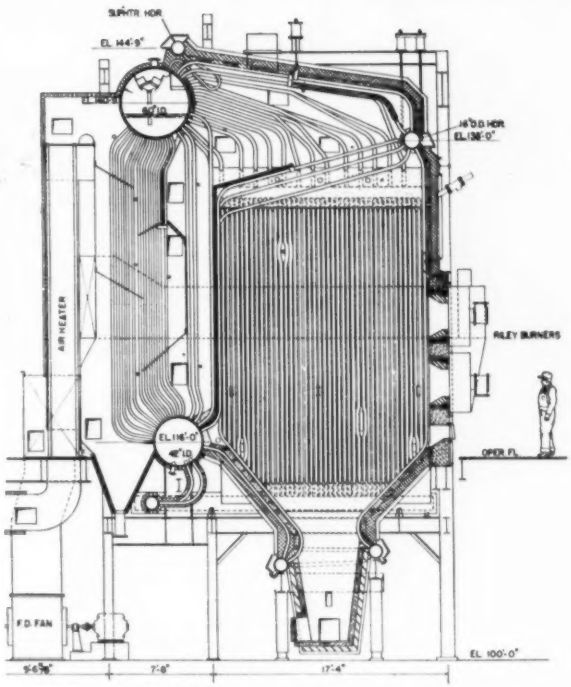
Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

It will pay you to visit modern Riley Installations

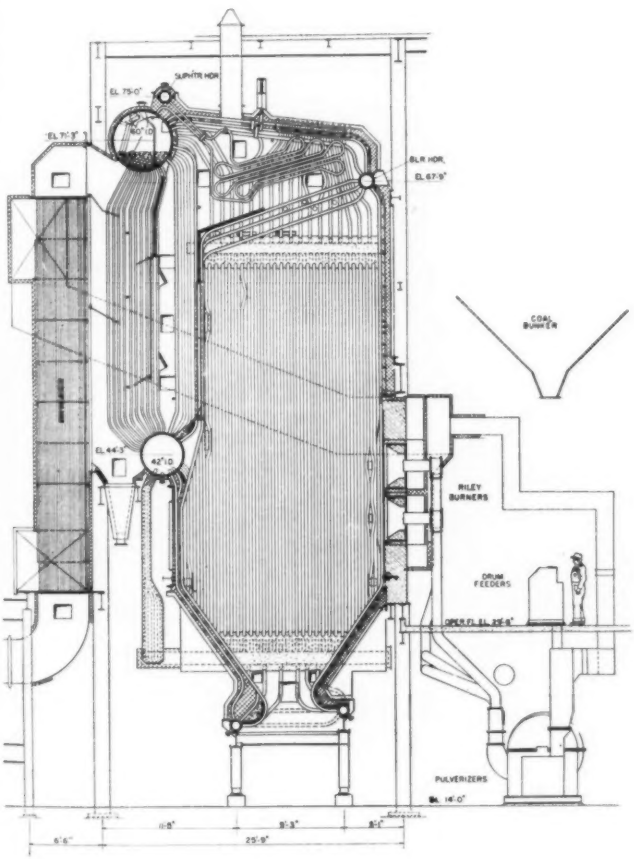
Generating Unit Installations

Because Riley Steam Generating Units give such service—because users are so thoroughly satisfied with the performance of Riley units—because they not only easily meet guaranteed performance but invariably exceed efficiency and capacity guarantees, a decided preference for Riley equipment has developed in recent years. Users know they can rely on Riley.

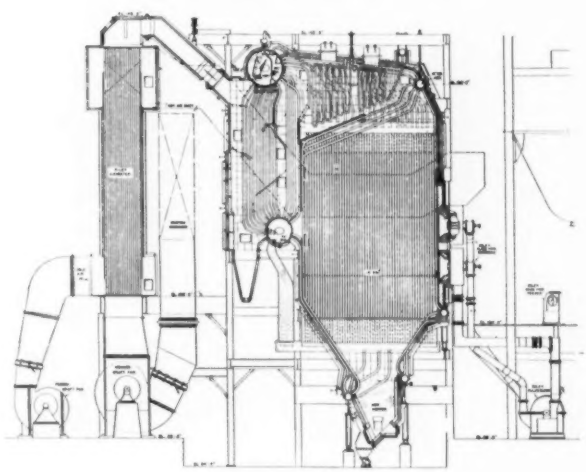
If you are considering new boiler or fuel burning equipment, ask Riley for recommendations. It will pay you to investigate Riley equipment.



Dayton Rubber Co., Dayton, Ohio
100,000 lbs./hr.—550 lbs.—Saturated
Efficiency 85.5%—Pulverized Coal Fired



National Lead Co., Sayreville, N. J.
250,000 lbs./hr.—450 lbs.—637°F.
Efficiency 84.7%—Pulverized Coal Fired



Penobscot Chemical Fibre Co., Great Works, Me.
200,000 lbs./hr.—475 lbs.—700°F. Riley Unit
Efficiency 87.5%—Pulverized Coal Fired

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

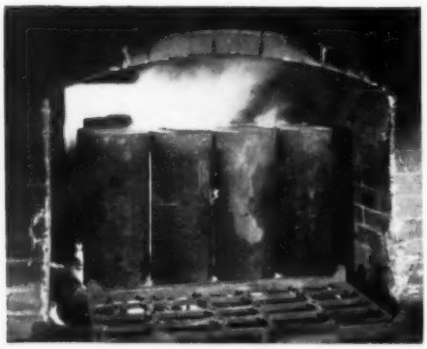
BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

...efore purchasing Boiler or Fuel Burning Equipment

8 A metal cylinder wrapped in wax paper roll is placed over assembly; wax sealing to steel mounting plate makes a liquid-tight container

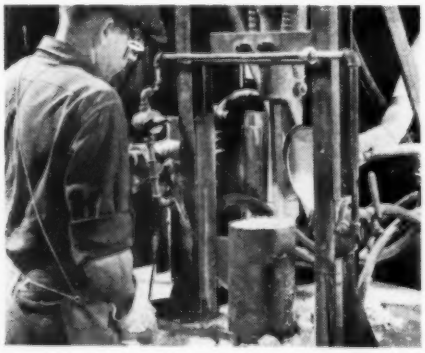
9 The container with wax assembly being carefully filled with chemically hardening investment material that forms the casting mold

10 After having been placed on vibrating tables to pack the investment tightly and aged several hours, molds are readied for the furnace



11 As molds progress through furnace in upside-down position wax melts out and finally burns during cycle lasting a period of several hours

12 Hot mold is clamped upside down on furnace and metal poured by inverting furnace. Air pressure forces metal into all mold cavities

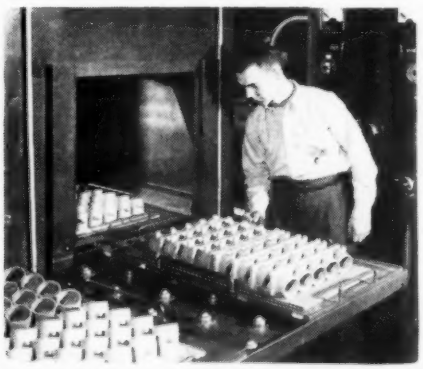


13 Mold cools slowly for about four hours after which pneumatic hammer knocks casting assembly from mold and removes investment

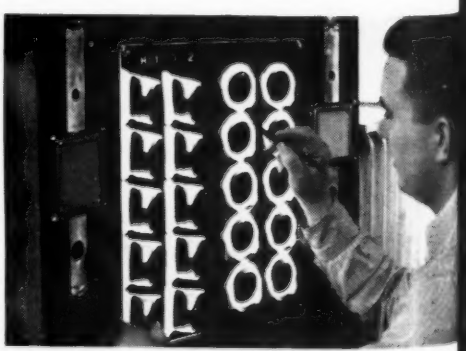
14 High-speed abrasive cut-off wheel cuts off the gates and risers from the metal casting before applying finishing touches and inspections

15 Castings are shot-blasted to remove scale and remaining investment material unless thin edges make treatment obviously inadvisable

16 Castings passing rough inspection are ground to smooth gate areas and any surface irregularities existing on either exterior or interior



17 Trays of castings pass through automatic X-ray equipment for final check on quality. Only one man is needed for supervision



18 Trained operators check all X-ray negatives closely for flaws that would make any individual metal casting unsuitable for application

OPA IS DYING—
. . . *what next?*

IT IS NOW clear that direct price control of the OPA type is on the way out, if not by legislative limitation then by administrative collapse.

It is equally clear that we are by no means past the danger of a swirling upsurge of prices.

Then does it follow that the passing of OPA need be tantamount to a decision to let 'em rip?

It does not.

While the OPA machinery is grinding to a stop, we can bring into play more fundamental measures to keep prices within safe limits—and to allow private management a wider area of freedom. What this article proposes is a framework of control within which private business judgment can operate. Therefore, this preamble speaks directly to our friends in the business community.

Now is a time for unrelenting self-restraint by business management. As price control disintegrates, business must scrupulously hold to prices which, after covering costs, yield *normal* profit margins. Business has everything to lose and nothing to gain if its price policies emulate the excessive wage demands made by some unions.

True leaders of business sense the danger. They do not want to price themselves out of their markets. They do not want the tag of price hogs. They do not want a buyers' strike. All management must practice the self-restraint which characterizes the wisest leaders among us.

What Wasn't Done

Virtually all responsible economic analysts agree that if direct price control is eliminated and nothing else is done, prices will move upward. The only serious disagreements are: How far? And for how long?

Some careful and competent forecasters believe that, if all price control is lifted, the official cost of living index will shoot up at least 25 per cent within a year. Some of them think that wage rates will chase right after prices, forcing new price increases until the whole operation ends in a dizzy crash.

Others agree that prices will go up all right, but they think that increased production, made possible by disentanglement from OPA red tape, will bring them down again fairly soon.

Recent developments seem to support those forecasters who think that wage increases would chase right after price increases and thus keep "the inflationary spiral" spinning toward a ghastly fall. Unions already agitate for a new round of wage increases to offset price increases which have occurred in the few months since the last round of wage increases.

Therefore, the prudent course would have been to clean up the OPA price control system, to keep it in place for a limited period as a stop-gap, and, meanwhile, to arrange to replace it with more fundamental controls, PROVIDED the federal government itself stopped promoting excessive wage increases. *The greatest single contribution to the wrecking of the OPA has been the holes driven in price ceilings by government-promoted wage increases.*

But now the stop-gap is being eliminated, and the fundamental controls are not in place. Their erection becomes urgent.

The Basic Task Now

The danger that prices and wages will get to chasing each other around a ruinous spiral arises, of course, from the accumulation during the war of an enormous sum of money that could not be spent because about 40 per cent of the nation's production was being devoted to war. Men were paid wages and profits for making artillery shells. The shells were exploded. The money remains. It has piled up until the people's backlog of cash spending power, in one form or another, exceeds $225 billions—three times the total in 1939.

More than that, banks hold $115 billions of government securities—a sixfold increase since 1939. These securities can serve as the basis for an expansion of bank credit of many times their volume. A dollar of bank credit will, of course, buy as much as a dollar of cash.

The first and basic task of preventing runaway prices is: *Get this huge accumulation of purchasing power, actual and potential, under some kind of effective control.*

A second task is to see that no unnecessary additions are made to the flood of purchasing power overhanging the market. A third task is to get the productive machinery of the country running at top speed so that it can take up the accumulation in an orderly way, not in a boom-bust sequence. We shall talk here only about the first two of these tasks.

Are there ways of getting at the root cause of a disastrous wage-price spiral which are being neglected? There are many of them. Attention has been distracted from them by building up the battle over OPA as the Armageddon of price stabilization. It is important. But it is not Armageddon. If everything that Mr. Bowles and his associates want done by way of price control legislation were done, the problem of price stabilization would still remain unsolved in the continued absence of a program to deal effectively with root causes.

Basic Remedies

Here is a rough outline of the key elements of a basic program.

1. Cut public expenditures to the bone and let tax revenues accumulate as business volume increases—perhaps broadening the tax base at the same time.

Now, if ever, is the time to run a surplus and to use it to retire debt. Immediate upward pressure on prices would thus be removed and the burden of carrying debt when the going gets tougher later on would be relieved. A $10 billion surplus of federal, state and local revenues during the next year might not be too much.

An increase in social security taxes, as the House Ways and Means Committee proposes, offers one of a number of good ways to increase revenues. Deferring public works not immediately needed affords one of numerous ways by which substantial cuts in expenditures can be made.

2. Tighten the terms on which installment credit is available for the purchase of houses, automobiles, and other consumers' goods.

Allowed to run a free course, expansion of credit to buy houses and durable consumers' goods might easily add $15 billion to consumer purchasing power next year. No such injection of credit is needed now. The more a man buys "on time" the more cash he keeps to spend on something else. For most products the cash market alone is more than big enough to keep producers busy and customers healthy.

3. Restore to the Federal Reserve system its lost control over the supply of credit by limiting the opportunities for credit expansion now afforded by huge bank holdings of government securities.

The specific measures needed are highly technical, but are agreed upon by banking experts as both feasible and fair. The important thing for the public at large to do is to recognize that we are, in effect, sitting on a powder keg with lighted match in hand until the measures are taken.

4. Revive a vigorous campaign to sell government savings bonds and other government securities to the public.

Sale of government savings bonds cuts down current consumer spending. It also allows the Treasury, if government spending is held down, to retire government bonds which the banks hold. Thus, it simplifies the problem of keeping bank credit within safe bounds.

5. Prevent a speculative inventory boom of the sort which preceded the post-World War I business collapse in 1920-21.

This involves a continuation of the loose controls of inventories now exercised by the government. In more important degree it involves well informed cooperation by bankers and business men to keep inventories from being expanded unnecessarily.

6. Maintain controls on exports in order to keep within reasonable limits the impact on our market of huge foreign demand.

Emergency foreign relief requirements must be met. But foreign demand which is enormous apart from relief requirements must be kept under control until the danger of having it send prices of export products soaring is past.

Breathing Space for Business

This program would deal with causes, not symptoms. Hence, if promptly and efficiently installed, it would do a far better job of keeping the general level of prices and wages within tolerable limits than the OPA type of price control ever could have done—even if OPA had not been so often and so badly mismanaged. The program would also do this without tying up American business in a myriad of irritating and discouraging individual regulations. It would establish broad bounds within which business enterprise would be free to be itself, not a branch of bureaucratic enterprise.

The program proposed here also has the major virtue of flexibility. If prices start to reverse their present upward course within another year, the major parts of the program can be adjusted or removed quickly.

It would be gratifying to suggest junking at once all arrangements designed to place limits on price movements, even broad limits of the sort here suggested. But to do nothing while OPA falls apart, would be to run the grave risk of a runaway of prices and wages which, in the inevitable collapse, would do irretrievable damage to the business community and to the whole nation.

The risk is not worth taking.

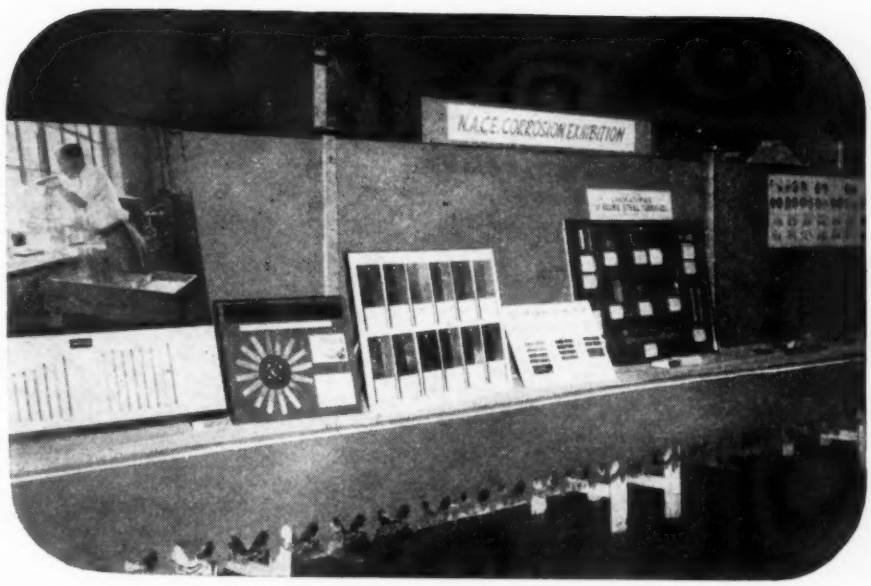
President, McGraw-Hill Publishing Company, Inc.

Electronic Probe Locates Faults In HEAT-EXCHANGER Tubes

▶ HEAT EXCHANGERS ARE EXPOSED to the constant threat of tubes corroding to the point of failure before defects are discovered. Of interest in overcoming this ever-present problem is a new instrument, the *probolog*, that charts a visible record of the defects in nonmagnetic tubes. Engineers witnessed its demonstration at the National Association of Corrosion Engineers convention and exhibition in Kansas City, Mo., May 7, 8 and 9.

New Electronic Device. The probolog is equipped with a flexible cable terminating in a sensitive magnetic probe, which travels through the tube at a constant speed. Imperfections or faults in the tube wall, such as corroded pits, dezincification areas, transverse cracks, longitudinal splits and wall thinning, are easily identified by properly interpreting the instrument chart record. Metallic baffles and tube sheets appear on the record as defects, but because they deflect the pen widely and at regular intervals, proper allowances can be made.

Inspection is speeded up by using a neon-lamp indicator instead of the chart record and removing the probe cable from the automatic puller. After adjusting the instrument for the proper sensitivity the operator pulls the probe through each tube as rapidly as he can. The neon lamp flashes whenever the probe transmits a signal exceeding a specified minimum intensity, and these tubes are marked for test with the recorder in operation. Instrument pen is set at zero by inserting the probe in a good tube before beginning the test. Record of a faulty tube shows up as a series of deflections, from the zero line (center of chart) whose magnitudes are proportional to the extent of damage. At present the instrument is designed specifically for tubes of copper, brass, monel, Admiralty metal, copper-nickel, aluminum, magnesium and austenitic stainless steel.



NACE exhibit displays metals and alloys subjected to sulphur corrosion, dezincification, impingement attack, atmospheric corrosion

CORROSION PREVENTIVES

Manufacturers' Exhibits. On display were products to prevent, minimize or eliminate corrosion in various industries. Products ranged from new compressor valves, nickel-alloy parts, pipe-coating material and wrapping machines, holiday testers—instruments that detect pipe-coating faults—to rectifiers and anodes for cathodic protection of pipes and tanks.

Papers on Corrosion. At the technical meetings papers presented covered a wide range of industries and discussed corrosion problems peculiar to each.

J A Keeth, Kansas City Power & Light Co., in his paper, "Corrosion in and Around Generating Stations," discussed corrosion problems that confront the power engineer. He suggested that steel-tube economizers be protected on the water side by properly operated deaerators and bypassing a small amount of boiler blowdown water through the economizer to raise the feedwater pH.

Sulphur corrosion on the gas side of economizer and air preheater can be minimized by recirculating part of the heated water and air to keep flue gas above the dewpoint. Breechings and stacks can be protected by guniting the inside or insulating the outside. Latter remedy prevents the gas cooling to its dewpoint temperature.

Mr Keeth also pointed out that concentrated heat, applied to boiler tubes containing water and steam, may break the steam down into hydrogen and oxygen causing rapid oxygen corrosion and hydrogen attack. In the furnace, tube washing from slag and CO can be minimized by maintaining an oxidizing rather than a reducing atmosphere in areas of attack.

Dr R B Mears, Aluminum Company of America, in "Condenser Tubes of Aluminum Alloys," explained the chemical characteristics of aluminum and its alloys that make them useful as condenser and heat-exchanger tube materials. They are highly resistant to oxidation, organic chemicals, even at high temperature and in the presence of water, sulphur compounds, ammonia or carbon dioxide, and inorganic materials such as nitric acid, hydrogen peroxide, boric acid, chromates, and substantially neutral alkali salts.

As for water contact, samples thus far studied indicate that aluminum is definitely anodic to copper-base alloys, and generally is not suited for contact with tubes, tube sheets or headers made of the latter material. Aluminum-alloy tubes are used successfully in cast-iron or steel vessels, and in some waters the aluminum is cathodic to the iron or steel parts and thereby protected by them. In other waters little or no galvanic action occurs between the two metals or, again, the aluminum may be anodic to the iron and suffer appreciable attack.

Alclad tubes, those equipped with inner-wall protection, are more resistant to corrosive waters than the regular aluminum alloys. Also, certain waters, highly corrosive to ferrous materials or nonferrous alloys, have little action on aluminum-alloy tubes.

German Underground Power Plant

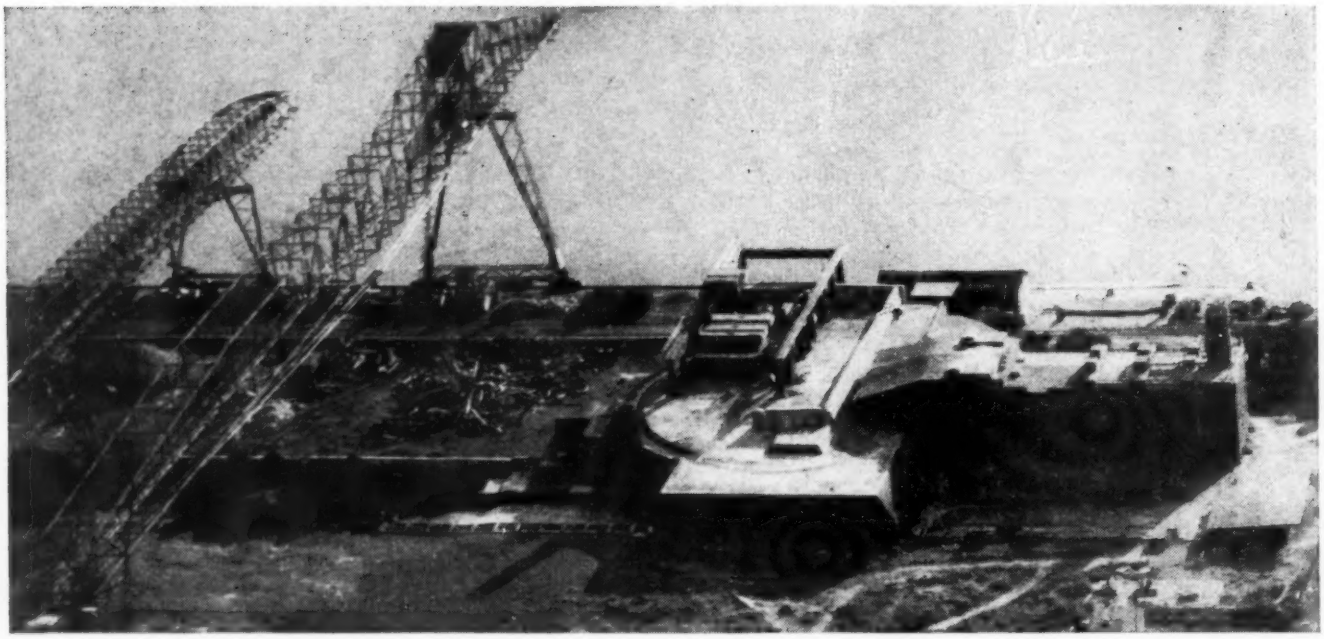


Fig. 1—Aerial view of bombproof plant shows extension of main structure above ground (center) and stub stack (right)

Withstanding all air attacks 'Werk Fritz,' 32,000-kva underground power plant in Mannheim, Germany, operated throughout the war. Analysis of design features shows the plant occupied less space and cost only 15% more than most designs

By CAPT FRED K McQUEARY AND LT KENWARD S OLIPHANT
Public Utilities Section, Industry Branch
Office of Military Government for Germany (U. S. Zone)

▶ INDUSTRY WAS MORE HEAVILY ELECTRIFIED in prewar Germany than in any other nation in the world. A vast system of transmission lines was built, in which a 220-kv line encircled the whole nation. Laterals of 110 and 60 kv crossed the country to strategically located substations, from which they fanned out in all directions. Additional generating stations were built in equally strategic locations.

In line with this expansion, Dr Fredrich Marguerre, director of 90,000-kw Grosskraftwerk at Mannheim, applied in 1937 for permission to enlarge his company's plant by adding a 35,000-kw unit. This request was denied, but another was submitted that proposed to take the new unit underground, making it bombproof and impregnable to air attack because enemy territory was near.

In answer to the authoritative "impossible" Dr Marguerre submitted plans to 'prove he could build a power plant underground and completely bombproof it for an outlay of only 15% more than a conventional plant. Impressed, Germany's war-production bigwigs granted permission to increase the capacity of the generating station by 32,000 kw, provided the new unit was installed as a complete and separate bombproof plant underground.

BOMBPROOF DESIGN

The Grosskraftwerk director, Dr Marguerre, did much of the actual designing. The plant was laid out as a complete and independent unit, with the natural limits of space and cubic volume always in mind as an influence to the layout.

The designer planned reinforced concrete at least 10 ft thick for the roof of the building. Ground-water pressure and the nearness to the Rhine River influenced the decision to make the building circular in shape. The Germans were well trained in bombproof construction, but here extra consideration had to be given to the type of equipment to be housed in such a structure. What effect would movement and concussion have upon power-plant equipment? What measures would have to be taken to prevent rupture of instruments? What additional tolerances would have to be allowed in the turbine-generator?

The bombproof, reinforced-concrete cylindrical shell with a 10-ft roof was constructed on the bank of the Rhine where water and coal were accessible. The structure extends below ground 54 ft, and above only 19 ft. All that is visible of the plant from above ground is shown in Fig. 1. The shell has an inside diameter of 111 ft and a height of 74 ft from the ceiling to the lowest level of the floor.

Machinery Fitted to Space. The building was not designed to fit the machinery, but rather the machinery fitted to the building's peculiar design. There was no room for a separate bunker and coal-milling house, a separate boiler

Survives War Bombardment

room or a separate machine house. Because the total plant had to be fitted to one circular room, a T-arrangement was decided upon for the turbine-generator and the boiler. Fresh air was provided and the chamber was pressurized slightly above one atmosphere with six forced-draft ventilators installed around the walls near the ceiling.

OUTSIDE CONNECTIONS

The plant is entered through a 330-ft tunnel directly beneath the coal yard. Extending along the tunnel are high-pressure steam-and-oil circulating pipes, which interconnect the underground plant with the 90,000-kw surface plant so steam can be interchanged between the two. In the same tunnel is a wide belt conveyor that receives fine bituminous coal by gravity feed along its full length. A screw conveyor, made necessary by the pressurized chamber, receives the coal from buckets and delivers it to the bunkers. Fig. 2, 3 and 4 show the plant layout.

Firing Conditions. Fuel was a washed fine bituminous coal obtained from the Ruhr district. It averaged 12,600 Btu per lb and contained 10 to 12% moisture, 30% volatile matter, 49% fixed carbon and 9% ash.

Combustion air is supplied by two variable-speed forced-draft fans mounted in louvers in the air ducts. These, plus the natural draft created by the pressurized building, and a final 10% induced by a third fan in the stub stack, create the draft. Ljungstrom air preheaters are located in the two forced-draft ducts.

Because of its high carbon content 80% of the flyash is returned for refiring. Remainder is transferred to the ash-and-slag-removal system.

Siemens Lurgi Cottrell-type electrostatic precipitators are partially extraneous and partially a part of the concrete flue-gas duct, which is below ground extending beyond and away from the main structure. The stub stack rises from the end of the duct, see Fig. 1.

DELIVERY TIMED

Fabrication of turbine-generator, boiler, and all other equipment was timed with the progress of the construction. The separate parts arrived as the building was ready to accommodate them, and the erection of the machinery was made almost simultaneously with the

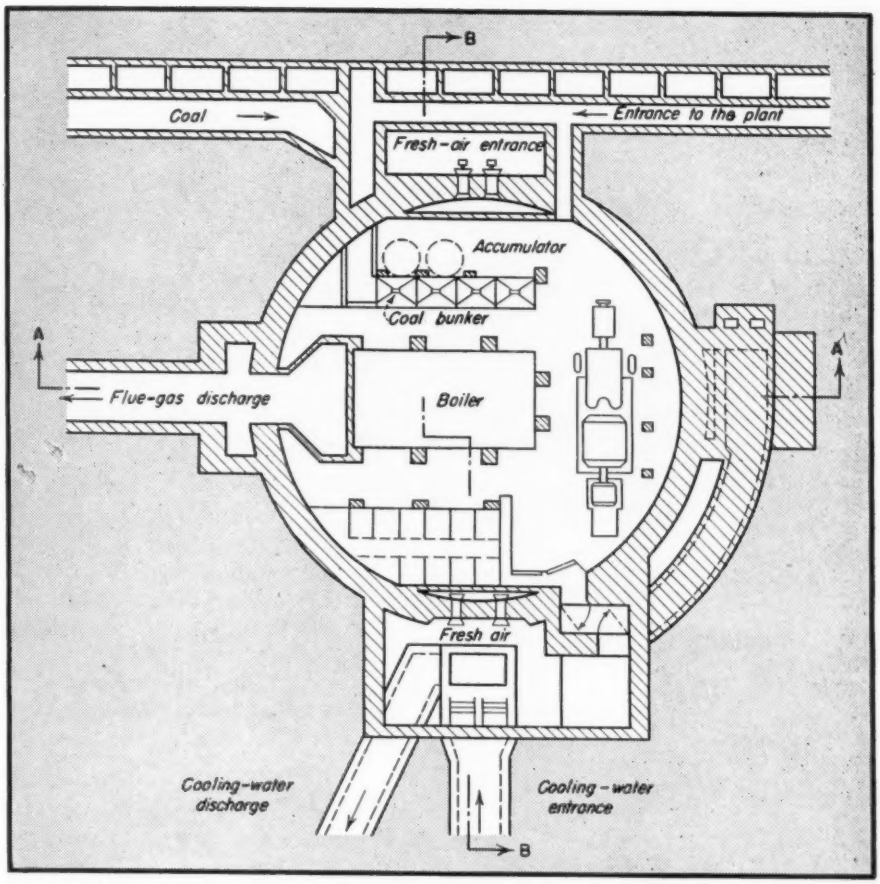


Fig. 2—Plan view of underground power plant shows outside connection through coal and entrance tunnels, and fresh-air, flue-gas and water ducts. Compactness of layout is demonstrated by crowding all equipment into space normally allotted to the boiler room. Special equipment was often selected to fit the available space and T-arrangement of turbine-generator and boiler is adapted to the circular room

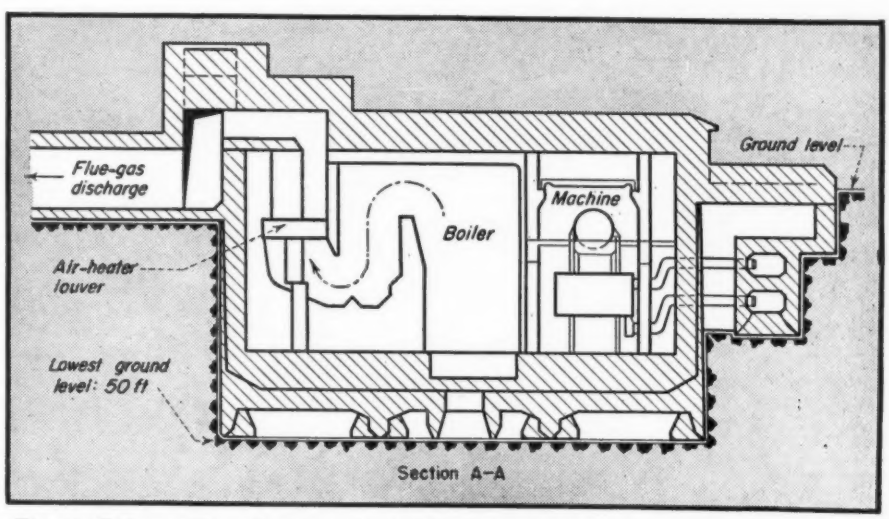


Fig. 4—This section of power plant shows the coal and entrance tunnels (left) and fresh-air-entrance ducts. Clearly revealed is method used to fit accumulators, coal bunker, boiler and switchboard into allotted horizontal and vertical space

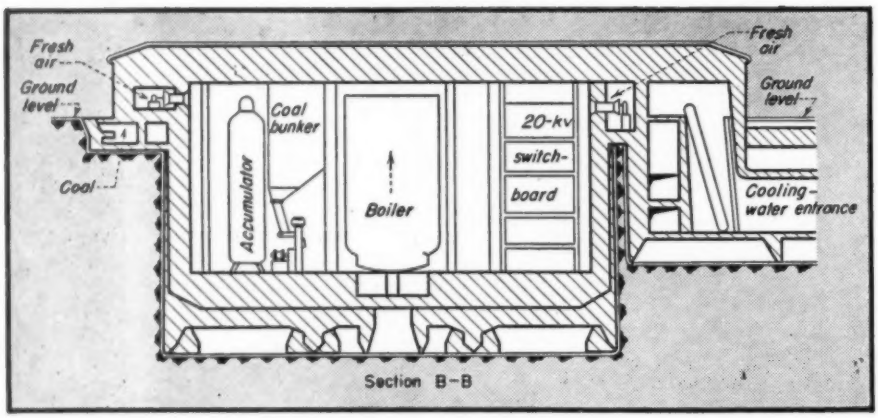


Fig. 3—Cross-section of power plant taken through the boiler and turbine. Location of condenser and cooling-water equipment is shown (right), and air heater and flue-gas duct (left). Ground level indicates exposed portion of main structure

completion of the building structure.

Because of the building's limited height, the Sulzer Co of Ludwigshafen built and installed a boiler of specially low design. Typical of such design, it has single pipes and forced circulation without the customary drums. It contains more than 42,600 ft of tubing, whose arrangement is similar to that of the Benson boiler. The superheater, economizer and tubular air preheater are of conventional design. Two centrifugal water chambers were inserted ahead of the first and second superheaters to insure dry steam. Since forced-circulation boilers can neither be started nor regulated without external pressure, two air-storage tanks of 3540-cu-ft capacity, each at 295 psig, were installed. The boiler produces 275,000 lb per hr at 1690 psig and 932 F. In spite of the compactness of the boiler and its other special characteristics, efficiency of 86% was obtained.

In providing a uniform flow of steam to the turbine, according to its demand, only two accumulators are used. These are of the vertical type.

WATER SOURCE

A surface condenser of rolled-in tube construction provides cooling with water direct from the Rhine through circulators that are actually below the river's level. Pumps are needed only to remove water from the condenser and return it to the river through another duct. No recirculation or chemical treatment is necessary.

Chemically treated river water, made up from evaporation from the interconnected surface and underground plants, is fed to the boiler by two Sulzer 11-stage centrifugal pumps driven by 1000-hp variable-speed motors.

All the motors in the underground plant operate at 1000 v. This is a departure from the 6000-v motors customarily used in German power plants. They are totally inclosed and are individually cooled by recirculated air cooled by ground water. The cooling water maintains a temperature of 44 to 47 F, both winter and summer. Some 2410 cu ft per hr of water are required. The heat could not be dissipated into the building because it would have to be removed from the total interior. Temperature throughout the plant is only slightly higher than outside surface temperature.

ELECTRICAL FEATURES

In designing a unit consistent with the over-all plan of fitting a complete power plant into limited space in an underground chamber, several departures from normal German design had to be made. From the first, consideration was given to eliminating the usual transformer between the generator and the transfer bus; therefore a 21.7-kv generator was used. The complete turbine-generator unit was built and installed by Brown Boveri and Cie, of Mannheim, and so far as is known it is the only 21.7-kv unit in Germany.

The turbine is a tandem-compound two-axial-flow action-reaction unit operating at 1482 psi and 932 F at the throttle. Boiler reheating, performed at 325 psi and 795 F, is introduced between the high- and low-pressure stages. Thermally the turbine is 80% efficient, and its mechanical efficiency is 98.5%.

The main generator is rated at 40,000 kva, 75% pf, and turns at 3000 rpm. Excitation is 250 v dc at 450 amp. The stator is Y-connected with an underground neutral. Mica peep windows at either end of the generator afford observation of any corona developed because of the ersatz-mica insulation.

A 3100-kva 1000-v 80%-pf station generator is mounted on the same shaft with the main generator and its exciter. An auxiliary exciter completes this unusually long assembly.

The generator is connected directly to a 20-kv bus through a 2000-amp (Allgemeine-Elektrizitats-Gesellschaft) 250-psi compressed-air circuit breaker. This is the type of circuit generally used throughout the vast central station-transmission grid system in Germany. The interrupting capacity is 800,000 kva.

The station's power is furnished not only by the house generator, but by an emergency, outside connection through a 3100-kva 3-phase 3-winding transformer, direct-connected to the underground station's 20-kv bus. Secondary voltages of 1000 and 400 are also provided.

Construction was started early in 1938 and completed three years later. The plant was given the code name, Werk Fritz, which it is called today.

EXPERIMENTAL PLANT

It was to become a sort of experimental plant for proving that the additional cost of making a steam plant bombproof was within reasonable limits. Grosskraftwerk now looks upon the forced-circulation boiler as unsound in an isolated plant intended to operate independently in case of serious damage or destruction of the main plan. Difficulties in stopping and restarting were experienced, and without the aid of the steam connection with the main plant they would have been greater.

Efficiency High. In spite of design and construction sacrifices to crowd a total plant into a confined and underground area with slightly more than 22 cu ft per kw of capacity, this plant operated at high efficiency. Its daily log shows that it operated almost continuously at near peak capacity and produced electricity at 14,200 Btu per kwhr average.

Starting production in July 1941, Werk Fritz' short life came to an end on June 23, 1945. It was in full production when the badly bombed city of Mannheim fell to the 63rd Division of General Patch's 7th U. S. Army on March 29, 1945. The plant continued to operate until the coal supply was exhausted, when both the main and the underground plants had to shut down, for postwar disposition.

CORRECTION

In the special section, "Measuring and Controlling Temperature and Pressure," *Power*, April 1946, Allen-Bradley Co should have been listed as a contributor.

THE OPERATING ENGINEER

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS—ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

BOILER PATCHES: Bolted, Riveted or Welded?

Harry M Spring discusses the relative merits, fields of use and, where possible, physical tests of the three major classes of boiler patches for maintenance. The first of two articles

▶ PRESENT DELAYS IN DELIVERY DATES of new boilers, eighteen months to two years for some designs, place continued emphasis on patches to extend the operating life of many frankly old equipments until modern units can be obtained. Properly designed and installed patches serve as an effective maintenance means of replacing defective portions.

Boiler patches divide into three general groups: soft, riveted and welded.

Today a soft patch finds little use. Its installation directly over a defective area, without cutting out any original plate, limits its application. For instance, the double thickness of metal at a patched area would probably overheat and burn if exposed to radiant heat from a fire or subjected to high-temperature gases. Accordingly, its service is confined to locations where over-heating cannot result.

Use of Soft Patches. A working advantage of the soft patch is its application by patch bolts from one side only of the plate. Tapped holes receive these patch bolts so no need exists for help in bucking or holding, as with rivets.

One specific place where a soft patch can be applied is the outer side-sheet or shell of a locomotive. A second somewhat similar application is the shell of a Scotch boiler or other internally fired unit where a patch is unaffected by heat. A third possibility is those locations where tube removal would present difficulties under any other method requiring access to the interior. It must be borne in mind, however, that a soft patch in an unstayed area has to comply with the same requirements met by riveted patches. Sealing soft patches requires use of grommets or packing. Many varied packing materials have served in making a patch leaktight.

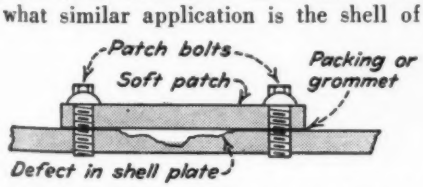
Riveted Patches. These prove useful in that they are adapted for exposure to furnace temperatures if properly designed. The following general rules cover design and specifications for riveted patches.

1. Use a patch plate of same material and tensile strength as the plate it replaces.

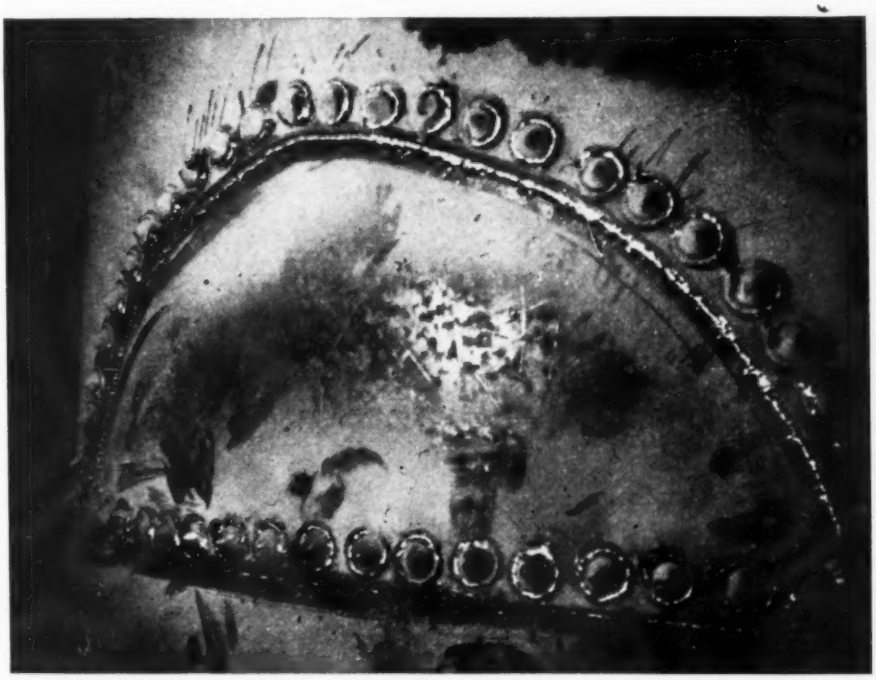
2. Thickness of patch plate should at least equal thickness of plate replaced, but should not be over $\frac{1}{8}$ in. thicker. Exposure of a lapped plate of excessive thickness to furnace temperatures leads to overheating and fire-cracking.

3. Angles of patch seams in an unsupported area should be such that equivalent efficiency of the joint will not weaken the boiler shell. (More on this subject follows.)

4. Size of rivet holes, pitch of rivets and lap of plate should be the same as that of girth joints in general. Some lati-



Soft patch shows double layer of metal, tapped bolt-holes, grommets for sealing



Defective area has been cut out and replaced with a riveted patch. Advantage of a well-designed riveted patch is ability to withstand high furnace temperatures

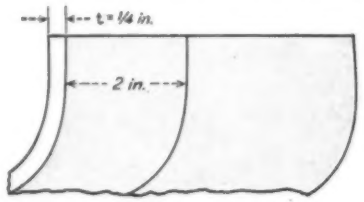
EFFICIENCY OF RIVETED JOINTS

Measure by: $\text{Eff} = \dfrac{\text{Strength of weakest part}}{\text{Strength of solid plate}}$

Given: Rivet pitch (P) = 2 in. Plate thickness (t) = ¼ in.

Rivet holes dia (d) = 1/16 in. = 0.687 in.

Rivet shank area (a) = .687 in. x $\pi/4$ = 0.371 sq in.



Solid plate, 2 × ¼ in.; no stress

Strength Under Stresses

Condition A

Tensile strength of plate = 55,000 psi = TS :. 55,000x2x¼ = 27,500 lb

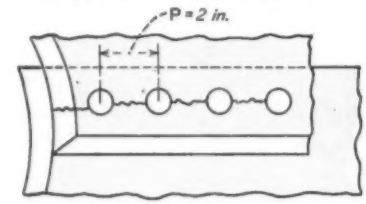
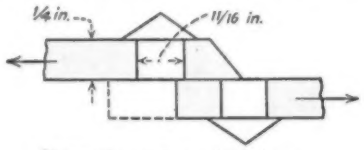


Plate torn between rivets; under tension

Condition B

Tensile strength of plate = 55,000 psi = TS :. (P — d) x t x TS = (2 — 0.687)x¼x55,000 = 18,100 lb



Rivet sheared, under shear

Condition C

Shearing strength of rivet = 44,000 psi = Ss :. Ss x a = 44,000x0.371 = 16,310 lb

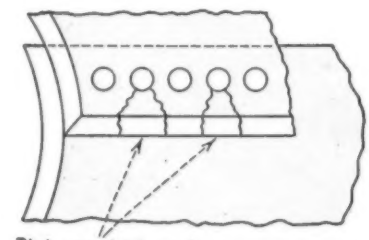


Plate crushed, under compression

Condition D

Compression strength of plate = 95,000 psi = C :. d x t x C = 0.687x¼x95,000 = 16,300 lb

$$\text{Eff} = \frac{\text{Condition D}}{\text{Condition A}} = \frac{16{,}300}{27{,}500} = .593 \text{ or } 59.3\%$$

tude exists here to allow bringing up the equivalent efficiency slightly.

5. A riveted-patch joint for high-temperature exposure should always be single lap.

6. After a riveted patch has been calked and found tight under hydrostatic test, rivet heads may be seal-welded if desired. Electric arc-welding with a single, small bead should be used.

Evaluating a Joint. In addition to these general design rules some method of evaluating a riveted joint proves helpful. Accordingly, discussion of calculated and equivalent efficiencies is in order. Calculated efficiency expresses the ratio in percentage between the calculated strength of a joint and the strength of the solid plate. This factor of calculated strength is based on the weakest part as influenced by design. This weakest part could be the joint's strength against failure between rivet holes, rivet shear, or the crushing of the plate itself in front of rivets, or possibly a combination of failures.

EFFICIENCY FACTOR

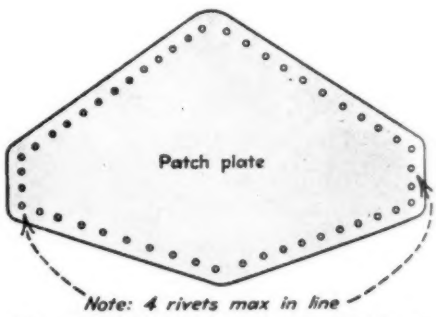
If a riveted joint is longitudinal in direction, its strength or efficiency constitutes a directly proportionate factor in the strength and hence the allowable pressure for the shell. As the angle of the patch seam increases from the horizontal, that is goes farther from coinciding with the longitudinal axis, its effect on the strength of the boiler shell decreases. Finally in its most extreme departure, a patch seam at right angles to the horizontal or longitudinal axis, the patch effect on shell strength becomes zero and its equivalent efficiency is then 100%. Stated another way: As the angle of a patch joint departs from the horizontal axis, its equivalent efficiency increases. The illustration, at bottom of p 105, expresses this statement by drawing to scale a patch that shows the method determining the influence of angularity of patch seams on boiler-shell strength.

By applying an appropriate multiplying factor, calculated efficiency of a patched joint gives the equivalent efficiency of the patch's effect on boiler-shell strength. Such a method shows the possible influence that the patch has on the allowable pressure.

Use of the Factor. Before giving an example to illustrate the use of a multiplying factor some background must be advanced for its development. Good practice establishes this procedure. If the longitudinal length of the required cut-out in a shell does not exceed 24 in., make the total circumferential cut-out twice the length of the longitudinal one. Equivalent efficiency of the resulting patch seam equals at least the efficiency of the longitudinal joint.

In the event the longitudinal cut-out exceeds 24 in., the girthwise cut-out in large patches will be limited by the closing-in line or in some cases even the longitudinal joint itself. Thus, a new course seems sometimes more practicable.

Patch Effect on Boiler. The following procedure allows one to determine the effect of a patch over 24 in. long on the allowable pressure for a boiler. First, lay out the patch to scale on a plane surface with chalk, or do the same on a piece of paper. Then outline a right-angle triangle with its hypotenuse any convenient length, with the one proviso that the hypotenuse be superimposed on the diagonal seam of the patch. If the



Side view of large patch. In unstayed area the major axis should be girthwise

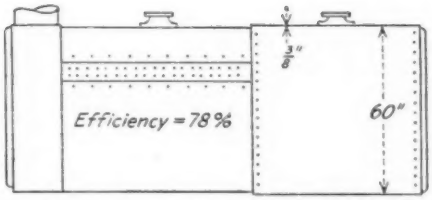
angle this diagonal makes with the longitudinal axis is 45 deg or less, these conditions are true to an accuracy of ± 1%: (1) The multiplying factor equals the hypotenuse divided by the horizontal leg of the right-angle triangle. (2) This factor, always greater than one, increases as this angle increases. (3) The effective or equivalent longitudinal efficiency of a diagonal seam becomes its calculated efficiency multiplied by a factor given by this ratio between hypotenuse and horizontal leg. Conversely: The required efficiency of a diagonal seam to be equivalent to that of a longitudinal seam is the efficiency of the longitudinal seam, divided by the factor found above. On the diagram and chart shown below, this factor and its elements are illustrated.

ESTABLISH THE FACTOR

As an example, if National Board charts are not available and a cut-out for a patch exceeds 24 in., apply the foregoing triangle method. Bear in mind that in locating the patch by a chalk outline on the shell, girthwise distance should be as high on each side as practicable, approaching twice the length of the longitudinal cut-out as a desired goal. Measure the outline of the patch and lay it out to scale. On this scaled drawing superimpose a right-angle triangle whose hypotenuse falls along the pitch line of the diagonal seam in keeping with the triangle method. Note that this hypotenuse may be any length. Now, let us assume some values for our example. Let the hypotenuse be 20 in.; the horizontal leg 15 in.; and the efficiency of the longitudinal seam 94%. Then our factor becomes $\frac{20}{15}$, or 1.33, F in diagram below.

With this factor established, to determine the required actual efficiency of the diagonal seam of the patch (provided the allowable pressure is to be maintained without reduction) divide the longitudinal-seam efficiency by the factor. This produces $\frac{0.94}{1.33}$, or 70.7%, as the required efficiency.

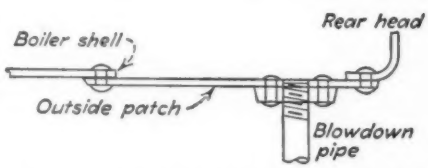
Determine Pressure. Next, to apply this knowledge. Of necessity, the riveted seam of a patch like this under discussion must be a single-lap seam. Its equivalent efficiency will invariably be lower than that of the longitudinal seam. So to (1) provide a seam as strong as practicable and (2) limit reduction in allowable pressure to a minimum, select a diagonal patch seam with a rivet pitch and diameter that results in the highest obtainable efficiency.



Tensile strength of plate = 55,000 psi

$$P = \frac{55{,}000 \times 0.375 \times 0.78}{30 \times 5} = 107 \text{ psi}$$

Strength of longitudinal joint directly affects allowable pressure of the shell



An exception to rule for inside patches shown is case for blowdown connections

If our subject boiler has a shell-plate thickness of $\frac{7}{16}$ in., then a $\frac{7}{16}$-in. patch plate with 1-in. rivet holes and a $2\frac{7}{16}$-in. rivet pitch gives us the highest efficiency by calculation. Let us say, however, that the chalk layout limits rivet pitch to $2\frac{3}{8}$ in.; then our actual or calculated efficiency comes to 57.8%.

Take this 57.8% and multiply by our factor of 1.33 and we get an equivalent efficiency of 77%. On the latter figure depends our allowable pressure for the boiler shell. To calculate this allowable pressure use the formula

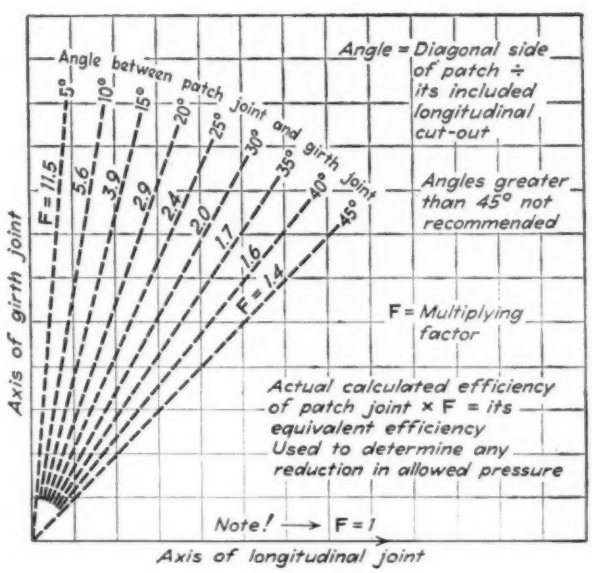
$$P = \frac{TS \times t \times E}{R \times FS}$$

Where P = pressure in psi
TS = tensile strength
t = thickness
E = the equivalent efficiency, as found above
R = radius of the shell
S = factor of safety

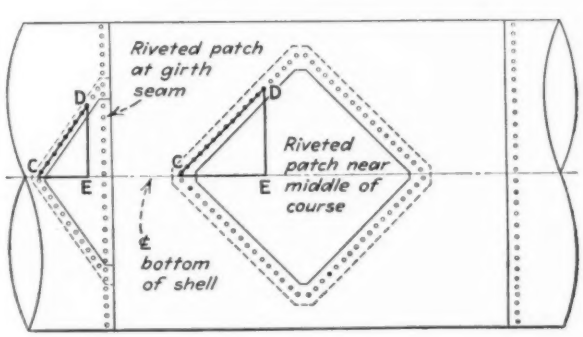
Results from this formula, while not 100% mathematically accurate, prove close enough for practical patch designs.

Special Designs. Before touching these it is best to recall that the nearer a patch approaches a girthwise direction the stronger it becomes as regards hoop stresses. With this understanding it is

(*Continued on page* 148)



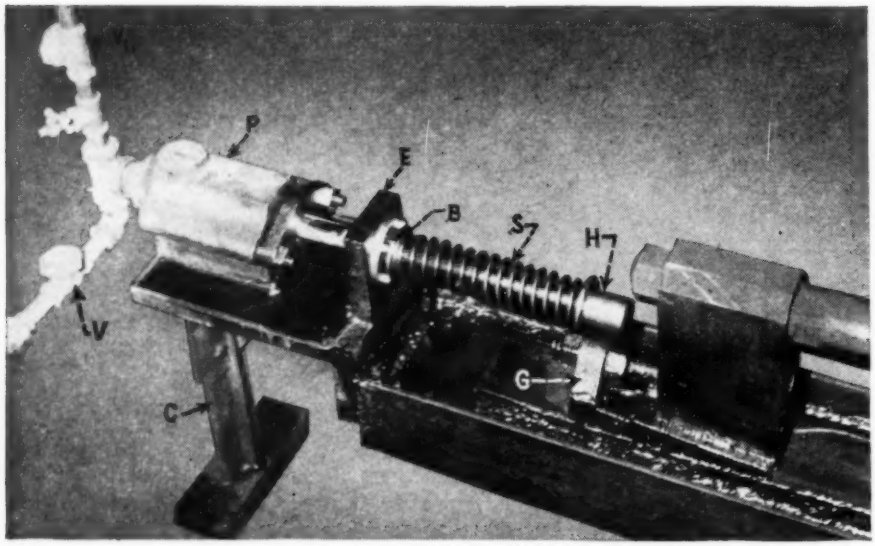
Left: Chart shows factor F increases as a patch becomes more girthwise. True girthwise seam does not affect shell strength; has 100% equivalent efficiency



Above: Triangle method determines factor F. Superimpose triangle CED with hypotenuse on patch seam; CE over CD gives factor for angles under 45 degrees

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men



FEED PUMP DRIVES TREATMENT FEEDER

TO IMPROVE THE METHOD of feeding treatment solution to our boilers we built pump *P* in the photo. It is operated by tailrod guide shoe *G* on the boiler feed pump. All parts of the pump were made in our machine shop. Its cylinder is bored at one end for a 1¼-in. piston and recessed for packing and a gland. At its other end the cylinder is bored and tapped for a ½-in. pipe nipple to which the suction and discharge piping connects. The pump is assembled on a base and bolted to the feed pump's tailrod guide support. To give the pump rigidity we placed an angle-iron column *C* under its outer end.

We bored vertical support *E* for a 1-in. split bushing to guide the pump's piston and limit its stroke to about 3 in. The piston is made of cold-rolled steel turned to 1¼ in. in diameter from the split bushing into the pump; the remainder is 1 in. in diameter, threaded on the end for driving head *H*. After the piston is put in the pump, split bushing *B* is fastened in place with capscrews. Assembly of the piston is completed with a spring *S* and threading on driving head *H*.

On the pump's liquid end a ½-in. tee tightened onto a nipple in the cylinder head provides for suction and discharge connections. Check valve *V* and V_1 serve as suction and discharge valves, respectively. Suction side of the pump connects to the boiler-water-treatment mixing tank and the discharge line goes to the feedwater heater. Treatment is mixed once each day and sufficient water is added to supply the pump for more than 24-hr operation. A feedwater connection to the tank with a float-controlled valve prevents the tank being pumped dry if for any reason the treatment tank is forgotten.

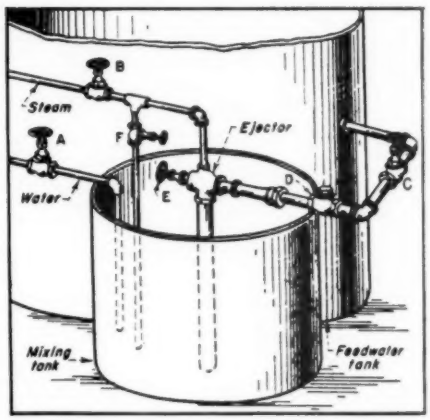
Operation of the treatment pump is simple. On the piston its driving head is so located that the tailrod guide shoe contacts it about 3 in. before the end of the feed pump's stroke. For the remainder of the stroke the treatment pump's piston is pushed ahead to discharge. On the feed pump's return stroke spring *S* returns the treatment pump's piston to suction position, ready for the next stroke. This pump has worked satisfactorily, delivering a measured quantity of treatment to the feedwater heater for every two strokes of the feed pump. Thus it insures uniform treatment of the water.

Boston, Mass. C O LONDON

Steam Jet and Mixing Tank Speed Chemical Mixing

THE ENGINEER IN ONE PLANT simplified mixing and delivering chemical solution to the boiler feedwater tank, as in the diagram. Cutting an empty 50-gal drum in half to form a barrel he installed it alongside the feedwater tank. Water and steam lines were brought into the barrel and a steam ejector connected to discharge the solution from it into the feedwater tank.

Chemicals are dumped into the barrel; to dissolve them, water and afterward steam are admitted by opening valves *A*, *B* and *F*. A paddle assists in the mixing and breaks up the large pieces. When the solution is mixed, valves *A* and *F* are closed and *C* opened in the line to the tank. A check valve *D* prevents flow from the tank into the barrel. The ejector is then started by opening valve *E* to force the solution into the feedwater tank.



Pomona, Calif. G M WILSON

Maintenance Tips For Steam Pumps

STEAM PUMPS are relatively simple equipment and will stand a lot of abuse and still keep going. However, this is no reason for neglecting them, when a little attention will keep them in good running condition and reduce operating costs.

The following eight pointers by Worthington will help to accomplish this end:

1. When starting a direct-acting steam pump make sure that valves in exhaust, suction and discharge lines, and all steam end drain valves are open before opening the steam valve. If pump is started cold, open the steam valve only enough to heat the steam end, before attempting to run the pump. Keep drain valves open until the pump makes a few strokes to drain off all condensation thoroughly. Failing to do this may seriously damage the main steam valves.

2. Lubricate all bearings, joints, moving parts, and piston rods before starting and subsequently at intervals when in operation. Lubrication should be frequent, but not so abundant as to gum or clog joints. Use a high-grade mineral oil in the steam cylinder and a lighter mineral or animal oil on the valve gear.

3. Most pump troubles are due to fouled liquid cylinders, worn valves, or conditions in the liquid-pipe connections outside of the liquid cylinders. Therefore, if the pump begins to perform poorly it is possible that the trouble is in the liquid end. Do not adjust the steam end until careful investigation shows that the liquid end is in good order.

4. Frequently inspect liquid-end piston packing to see that it is in good working order.

5. Occasionally inspect liquid-end valves. If of metal, regrind when worn.

6. Keep stuffing boxes well filled with a good quality of rod packing. If old packing remains in stuffing boxes long enough to become hard, it will score the piston rod. Do not screw up the stuffing-box glands too tight. Too much pressure will damage the packing and make it bind on the rod, causing scoring. Permit an occasional drop of liquid from the stuffing box. This shows that the packing is not too tight and the small leakage lubricates it.

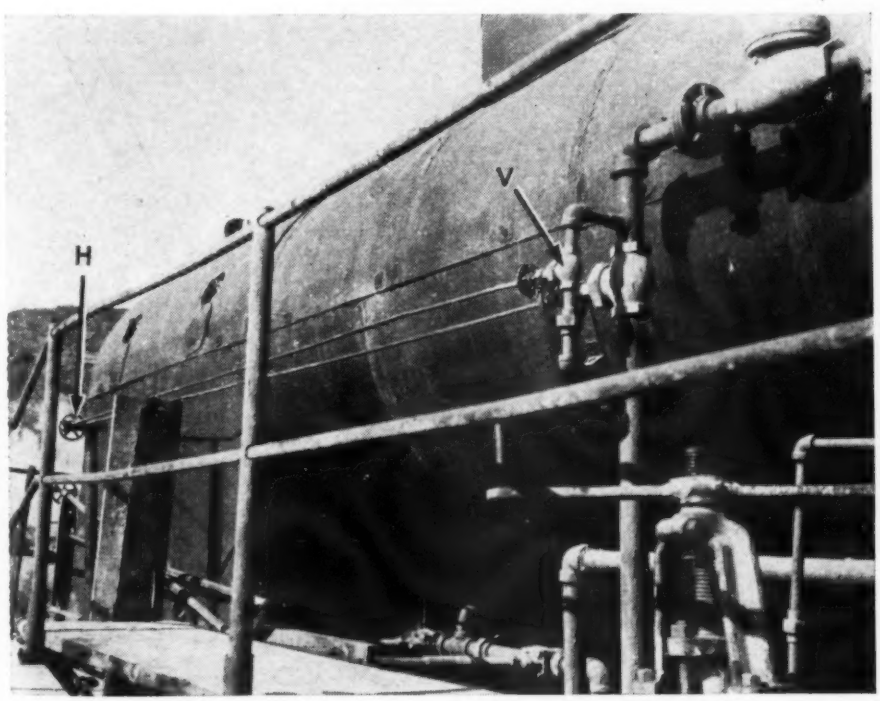
7. When the liquid contains foreign matter that might clog valves and pump passages, use a suction strainer with four to five times the area of the suction pipe. Locate the strainer where it can be frequently inspected and cleaned.

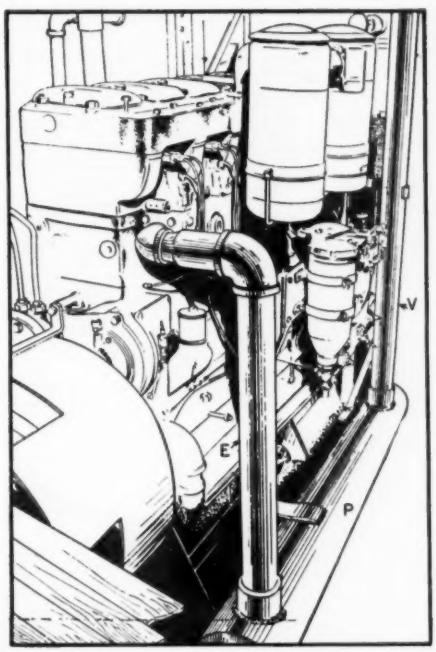
8. If pump is to be left idle for some time, fill lubricator with oil and open lubricator cock to let oil flow into the steam chest. Let pump make about six quick strokes to distribute the oil evenly over the inside of the steam end to eliminate danger of rusting. In cold weather, open all drip cocks, and drain all piping when pump is not in use, to prevent freezing.

BYPASS VALVE REGULATES FEEDWATER FLOW

REGULATION OF FEEDWATER FLOW to a battery of large outdoor boilers required considerable attention by the operators. At light loads it was difficult to adjust the feedwater line valve to meet steam demands. The plant superintendent solved this problem by installing a ¾-in. bypass around the main valve as at *V* in the photo. With the two valves, feedwater flow to the boiler can be adjusted from a trickle to maximum required by steam output. Main valve is used for medium loads and above, and the small one for light loads on the boiler plant.

To make it more convenient for the boiler operator the valves were set with their stems toward the boiler front. Extension rods with handwheels *H* were then run from the valves to the front end of the boiler. From here the operator can readily control feedwater flow without going out of sight of the gage glass. This arrangement not only reduced the amount of attention required to regulate the feedwater but it was a timesaver in labor-short boiler-operating crews.





Water-Filled Chamber Checks Exhaust Sparks

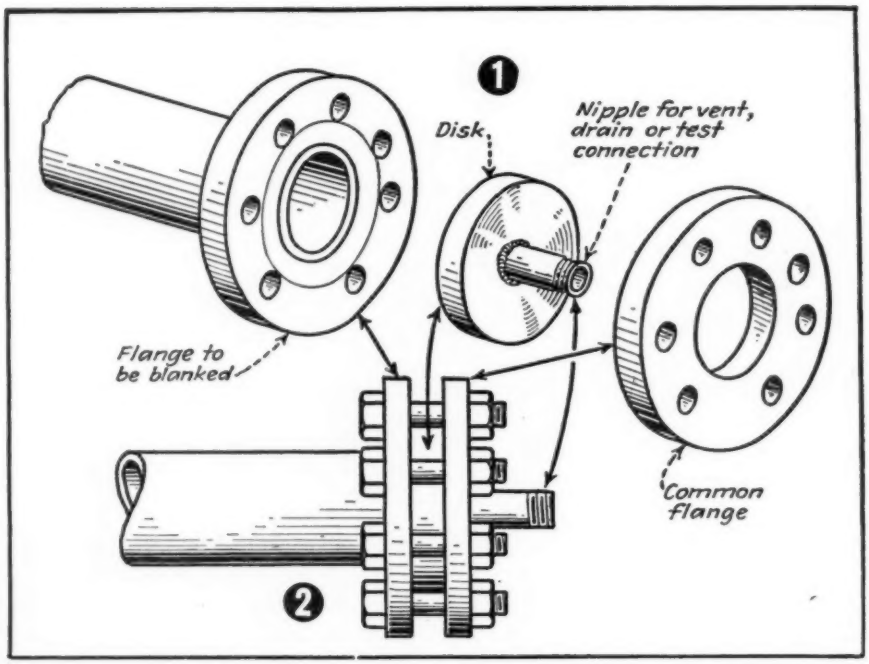
OPERATION of internal-combustion-engine power units where inflammable materials or explosive gases are present creates a problem of eliminating sparks from the engine's exhaust. In one plant to prevent exhaust sparks escaping to the air the plant superintendent installed a water-cooling chamber in the exhaust of each engine. He bolted a length of 8-in. pipe, *P*, along the exhaust side of the engine's base. Near one end of this pipe he connected the exhaust line *E* and near the other he extended vent pipe *V* to a point outside the plant.

He connected a small water line at one end of cooling chamber *P* and a drain at the other. The drain was placed to maintain the cooling chamber about

one-third full of water, the inlet valve being adjusted to maintain a slow flow of water through the chamber. The engine exhausts directly down on the water so any sparks are submerged, or at least cooled before they go out the vent pipe to the atmosphere. Exhaust blasts agitate the water, thus increasing the surface area against which the hot exhaust gas impinges.

This exhaust-gas cooler has the advantage of being built as part of the engine. If the engine is moved to a new location the cooler goes with it, which insures the new setting being the same as the previous one.

Pomona, Calif. G M WILSON

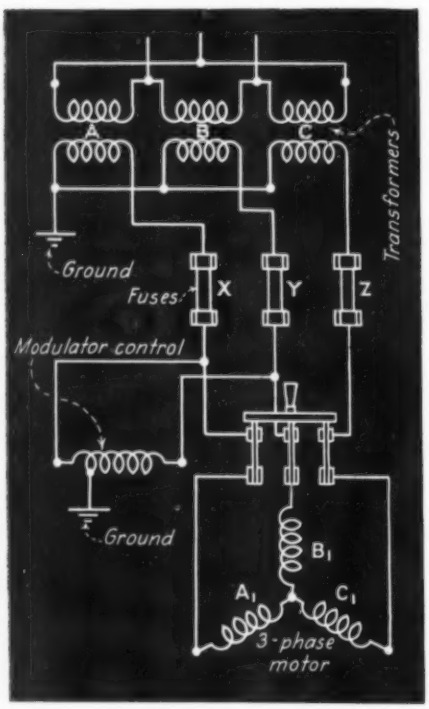


DISK PINCH-HITS FOR A BLANK FLANGE

FREQUENTLY when about to pressure-test a pipeline, tank or similar equipment enough blank flanges are not available with which to close all openings. Several times we have solved this problem as shown in the drawings. With a cutting torch we cut from steel plate a circular disk that just fits inside the flange bolts. When it is required, we cut a hole in the disk's center and weld in a short nipple with a valve for test, vent or drain purposes.

Make the disk about as thick as the flange, but it may be thinner for low pressures and small flanges. Fig. 1 shows the parts for blanking a flange, while Fig. 2 shows them assembled. Use a gasket on each side of the disk. One of the gaskets seals the disk on the pipe-end flange and the other prevents scarring the common flange's face. When installing the disk be careful to tighten the flange bolts evenly.

Bellingham, Wash. DEAN H BERGMAN



Did 3-Phase Motor Start Single-Phase?

IN THE HEATING PLANT of a large apartment house the 3-phase motor, driving a combination blower and oil pump, operated at an excessive temperature. Motor-winding insulation was found badly burned, short circuited in places, dirty and oil soaked. Tests and circuit tracing revealed that the motor had been operating with one of its three fuses blown. A 3-phase motor cannot start single phase. But once started and not too heavily loaded it will continue to run, but may operate at a dangerous temperature.

This motor's apparent single-phase starting raised the question: How did it start? A ground was found near one end of the winding on the modulator control that regulated the heating plants' dampers. This control connected to the motor circuit, as in the diagram. The motor and control operated on a 3-phase, 4-wire system with grounded neutral. When the modulator control grounded, practically a short circuit was formed on transformer *A*, through fuse *X*, a small part of the control winding to ground and back to the transformer, causing the fuse to blow. This disconnected transformer *A* from the motor, and left transformers *B* and *C* supplying the motor by what might be considered an open-delta connection with the two grounds forming the third power leg. The connection does not give a true open delta, and as a result the voltage applied to motor winding A_1 is only about 57% of that across the other two windings. This was, however, sufficient to start the motor and bring it up to speed, even though the motor operated continuously overloaded afterward.

Because the motor had to be rewound a temporary one was installed to get the heating plant back into service. As a motor of correct frame size was not available, the most convenient one was used and connected to the fan shaft by V-belt. The coupling threaded on the fan's shaft, which made it necessary to make an adapter on which to mount the V-belt sheave. In spite of all these difficulties the heating system went back in service before a building freeze-up occurred.

The Maintenance Co M A MYERS
New York, N. Y. Electrical Engineer

Preparing Steel Heating Boilers for Inspection

THOROUGH INTERNAL INSPECTION of steel boilers is difficult unless proper preparations have been made. Accumulations of deposits may hide a dangerous defect while improper cooling prevents close

examination. The following procedure will aid men preparing a boiler for inspection.

1. Allow boiler to cool gradually before draining. Rapid cooling may set up stresses that cause leaks and other difficulties. Emptying a hot boiler causes soft sludge to bake on hard, increasing difficulty of removal.

2. Remove manhole and handhole plates and any washout or inspection plugs.

3. Wash out boiler after draining. Sediment and sludge wash out much more easily if removed before they dry.

4. Clean the fire surfaces. All accessible tube, shell and head surfaces should be carefully brushed of soot and ash.

5. Don't permit steam or hot water to enter an open boiler. Tightly close valves on all steam, feedwater or blowdown lines. Attach to each valve on boilers with manholes a red tag labeled, MAN IN BOILER. Do not remove tags until sure that no one is in the boiler, and manholes and other openings are closed. Steam or hot-water leaks through a valve may be stopped by blanking the connection until repairs are made. A fatal accident may result from lack of proper caution.

6. Clean furnace and combustion chamber. Remove all soot, ash and refuse. Be cautious when stepping into ashes as they may be hot. Never play a water stream into hot ashes as this practice is hazardous.

7. Remove steam gage for testing. Boiler inspectors have equipment to test the gage and make minor adjustments when necessary.

8. Leave boilers open, empty and dry when not in use. Allowing steel boilers to stand idle and full of water for long periods promotes internal corrosion and pitting. Attach a sign to the firing door during summer months that reads, EMPTY BOILER: DO NOT FIRE.

Canton, Mass. HARRY M SPRING

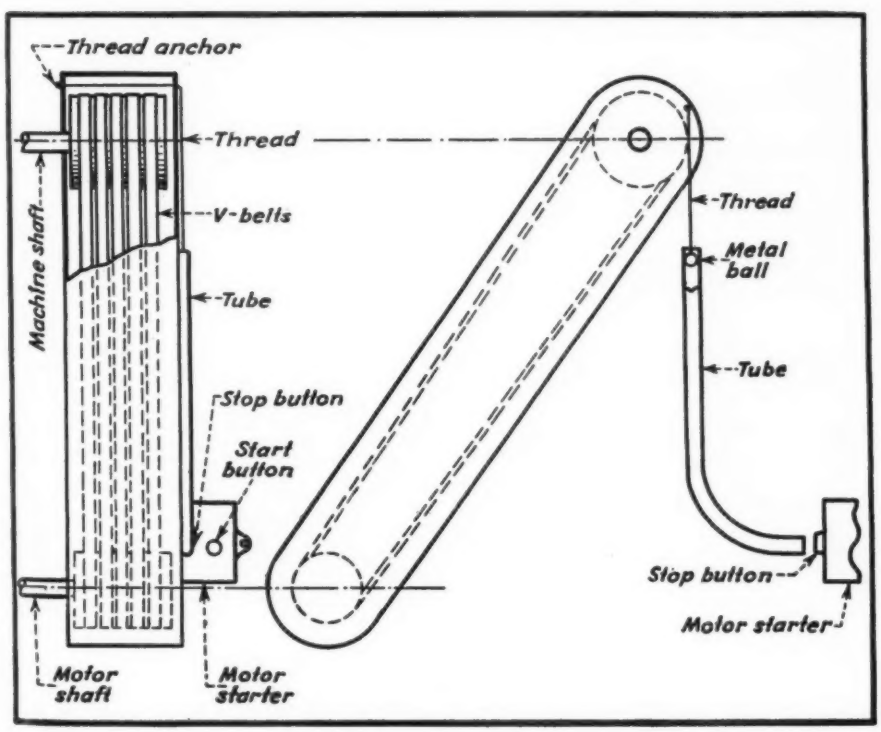
V-BELT FAILURE STOPS DRIVING MOTOR

IN OUR PLANT one machine is motor driven through a totally inclosed 5-strand V-belt. There is no way of knowing if one belt strand breaks. To let the remaining four strands continue running while the broken one is in the casing might completely wreck the drive. To eliminate this hazard we installed an automatic stop on the motor starter.

This stop consists of a piece of cotton thread, a metal ball and a length of tubing, arranged as in the figure. As shown on the left, the thread passes across the inside of the guard's upper end near the sheave. It is anchored to the casing's left side, passes through a hole in the right and connects to a metal ball suspended just inside the tube's top end, as on the right. The tube is bent and supported to bring its lower end in line with the motor-starter's stopbutton.

A belt strand that fails hits the thread and breaks it, freeing the ball, which rolls down the tube and hits the stopbutton to stop the motor. This rather simple device has worked successfully in practice and can be arranged in many ways to suit different equipment arrangements on the machine.

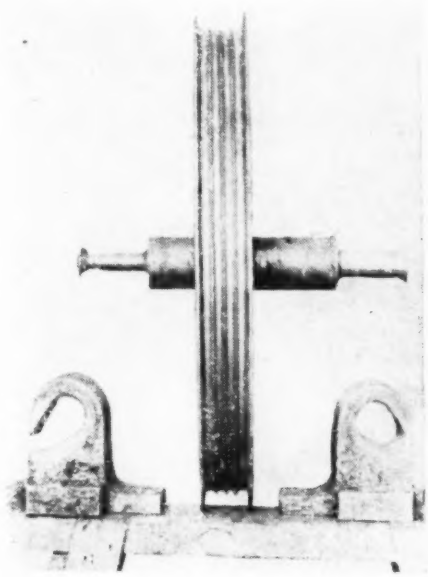
Leeds, England H MOORE



Sheave Shaft Cuts Through Bearings

WHEN LUBRICATION IS NEGLECTED almost anything can happen. The photo shows what did happen to an overhead sheave shaft and bearings of a hydraulic elevator. This condition was reported in *Vulcan*, a publication of the Vulcan Boiler and General Insurance Co, England.

The bearings 2¼ in. in diameter by 3 in. long were of ordinary cast iron on which the mild-steel shaft journals ran. Lubrication was through oil holes in the bearing tops. For some time before rapid wear started it was known that the bearings and shaft were worn but not enough to require replacement. However, most of the wear shown took place within a few months.



The bearings, which normally received regular attention, for some reason were neglected, and this caused their rapid destruction. The ropes made a right-angle bend over the sheave, and as a result the bearing wore at a 45-deg angle. On the left the shaft journal was nearly worn off when it cut out through the the side of its bearing.

READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

1—What Is Best Way To Remove Motor Coils?

I WOULD LIKE a simple, quick method of removing old burned-out coils from armature and stator slots. We have tried burning off the insulation but with modern types of insulation this doesn't work very well. So far we have used hand labor but would like to know whether some kind of machine or device has been found that saves time and labor.

I also want to know a good method for cleaning the old insulation and varnish from the slots. Again we experimented by using acid but it didn't work at all satisfactorily. Can POWER readers suggest some practical ways to perform these operations without purchasing a lot of expensive equipment?—HEG

2—How Can I Reclaim Flyash for Burning?

WE HAVE a spreader stoker in our hrt boiler. It was originally installed to relieve hand firing. The stoker works satisfactorily but we would like to reclaim some of the flyash. The breeching from the boiler connects near the base of the chimney. Excess flyash requires more clean-out at the chimney base than we used to have. I have noticed that flyash consists mostly of black coal particles that would burn if returned to the firebox.

Have POWER readers ever seen this done? If so what would be a good method of removing flyash from chimney base and forcing it into the firebox where a forced draft is used?—LBN

Answers to May Questions

What Causes These Boiler Tubes to Erode?

(This is Question 1 from the May issue, with best answers from readers)

During the past year one of our boilers has had three tube failures. They are not caused by overheating or scale, as we supposed, but result from some external abrasive action that eats holes in the tubes from the fireside.

The boiler giving trouble is a 554-hp unit with superheaters, and is fired by a chain-grate stoker. It is equipped with soot blowers. The damaged spots look as though the action of the jets causes the erosion, but we are not sure. Air is used in the blowers.

While the boiler has been in use about 20 years it has had good care. It supplies steam to a turbine, and the load has been rather constant. The tubes are well slagged, which makes it difficult to get them out.

It seems to me that the tubes should have lasted much longer. I would like to hear from other engineers who are POWER *readers. Can they tell me the cause of the erosion and suggest some remedies to protect the tubes?—CAM*

Weld Half Sole on Tubes

IF THE SOOT BLOWERS of *CAM's* boiler are located properly, there should be no danger from erosion. He should check to see whether the elements have shifted from their original position, and reset them if necessary.

Perhaps the air is not as dry as it should be and considerable condensation is forming on the tubes. This would erode tubes quickly, especially at the ends where metal is thinned. If water is the cause, a separator could be used in the air line.

Suitable half soles can be made by cutting an old tube into 6-in. pieces, then slicing them in half lengthwise. These could be tack-welded to tubes at spots where jet strikes, thus taking the erosion. Caution: Do not damage tube during welding.

Philadelphia, Pa. J S HAMILTON

Check Location Of Soot Blowers

I SUGGEST CAM check the position of the soot blower header-jets to see that they are delivering the air blast between the tubes immediately next to the jets and not directly upon the tubes. The latter may well be the case through some movement of the headers, boiler setting, wall warpage, cracked or warped headers. Jets enlarged by erosion or some abrasive action may also cause trouble.

Repeated erosion action deteriorates the tubes, reducing tensile strength to a point where failure results. Such stress may cause minute cracks in the tubes, which will be more readily attacked by corrosive gas from the furnace, causing rapid erosion on the outside of the tube as mentioned.

Therefore a complete check-up on *CAM's* soot-blower unit is advisable when the boiler comes out of service. Excessive slagging shows the soot blowers are not functioning properly.

Montreal, Que. ARTHUR BELTON

Certain Tubes Fail Faster Than Others

I SUBMIT MY OWN EXPERIENCE which is somewhat similar to *CAM's*. One of our boilers was installed about 23 years ago. Since then we have had no tube failures to speak of, apart from re-expanding a few in steam drum or header. The last row of tubes are called dry tubes. They are located between the steam space of the steam drum and header. These tubes are supposed to dry and superheat the steam. There are 19 tubes.

About two years ago we had this boiler out for inspection and hydrostatic test. We found four of the tubes perforated,

some of them in two or three places. These were of course renewed.

A month later the same boiler was out of service to renew grate bars. We decided to test the boiler tubes again. The test showed that five more tubes in the same row were leaking. We decided then that the remainder of the tubes were worn through and had outlived their usefulness. Therefore we retubed the complete bank of 19 tubes and have no more trouble.

Bronx, N. Y. T E MURRAY

Analyze Coal for Sulphur

TUBE FAILURES are probably caused by incorrect setting of the soot blowers and corrosive action of sulphuric acid. During the war years coal was difficult to obtain and *CAM's* coal is probably high in sulphur content. The moisture in the air line to the soot blower will combine with the sulphur products of combustion when the soot blowers are operated. This produces a corrosive substance that can cause a great deal of damage to the external surfaces. To correct this condition he should set the soot blowers correctly and send coal to the laboratory for analysis. If possible he should use coal with a lower percentage of sulphur in future.

I suggest that *CAM* deslag the boiler tubes because the slag blocks the flow of combustion gas.

Parr, S. C. V C SUMMER

Air Stream Hits Tubes

EVIDENTLY THE TUBE TROUBLE is caused by the action of the soot blower jets blowing directly on the tubes. The air from the jets carries with it a certain amount of soot or flyash, which in time wears a groove in the tube. Eventually it gives way under boiler pressure.

Most soot blower manufacturers furnish an adjusting screw on the head of the blower whereby the element can be adjusted lengthwise to suit the tube location. It is good policy to adjust the element so the jets do not impinge directly on the tube but rather to one side or between two adjacent tubes. Cleaning effect will be about the same and will eliminate the grooving. With staggered tubes this still works because the distance to the second or third row of tubes lessens the pressure and abrasive action of the jet.

Duluth, Minn. E R WEBBER

(*Continued on page* 140)

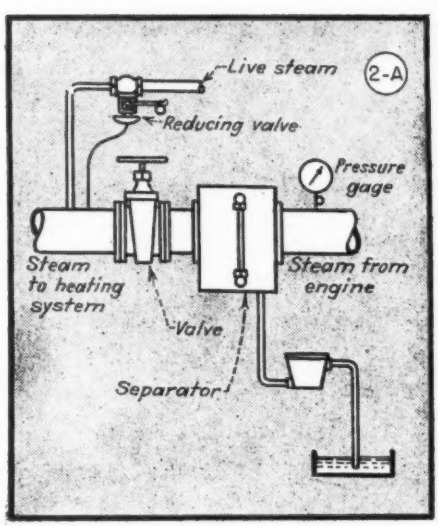
Why Doesn't Trap Work All the Time?

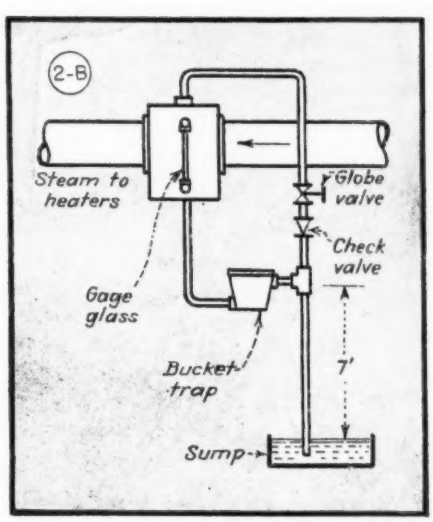
(This is Question 2 from the May issue, with best answers from readers)

The heating system in our building uses exhaust steam from a reciprocating engine. Near the engine in the exhaust line is an oil separator, which drains to the sump through a bucket trap, as in Sketch Q-2. Pressure in the exhaust or heating line varies from 20 to 12 psia.

Recently when we were working on the heating system, we found it full of cylinder oil. We immediately checked the operation of the oil separator, but it would not drain through the trap when the heating system was operating on a vacuum. Our next step was to check the trap. It was in good working condition—a fact that was borne out by its performance when the heating system was operating on pressure above atmospheric.

I cannot see why the difference in pressure should affect the operation of the trap, but it does. Can POWER *readers tell me why the trap refuses to function when the system is operating at a vacuum and how to correct my difficulty?—EEL*





Install Pressure Line

SINCE EEL DOES NOT INDICATE altitude I assume 12 psia develops a negative pressure on the trap. This makes it necessary to balance the pressure on trap outlet and also creates an unbalance through the longer water leg discharge. I suggest he install a tee on the discharge of the trap as in sketch 2-*B*. Connect top of tee to the separator above the water line with a check valve to stop reverse flow under pressure.

Bottom of tee should have a discharge pipe with a vertical drop of 7 ft or more. Lower end is sealed in sump water.

Brandon, Manitoba W A WYBORN

Admit Live Steam

THE REASON EEL'S TRAP does not function with a vacuum in the steam line to the heating system is that flow through the trap is reversed by air entering the open end of the lead pipe to the sump. To make the trap work, the pressure in it has to be greater than pressure in the discharge line.

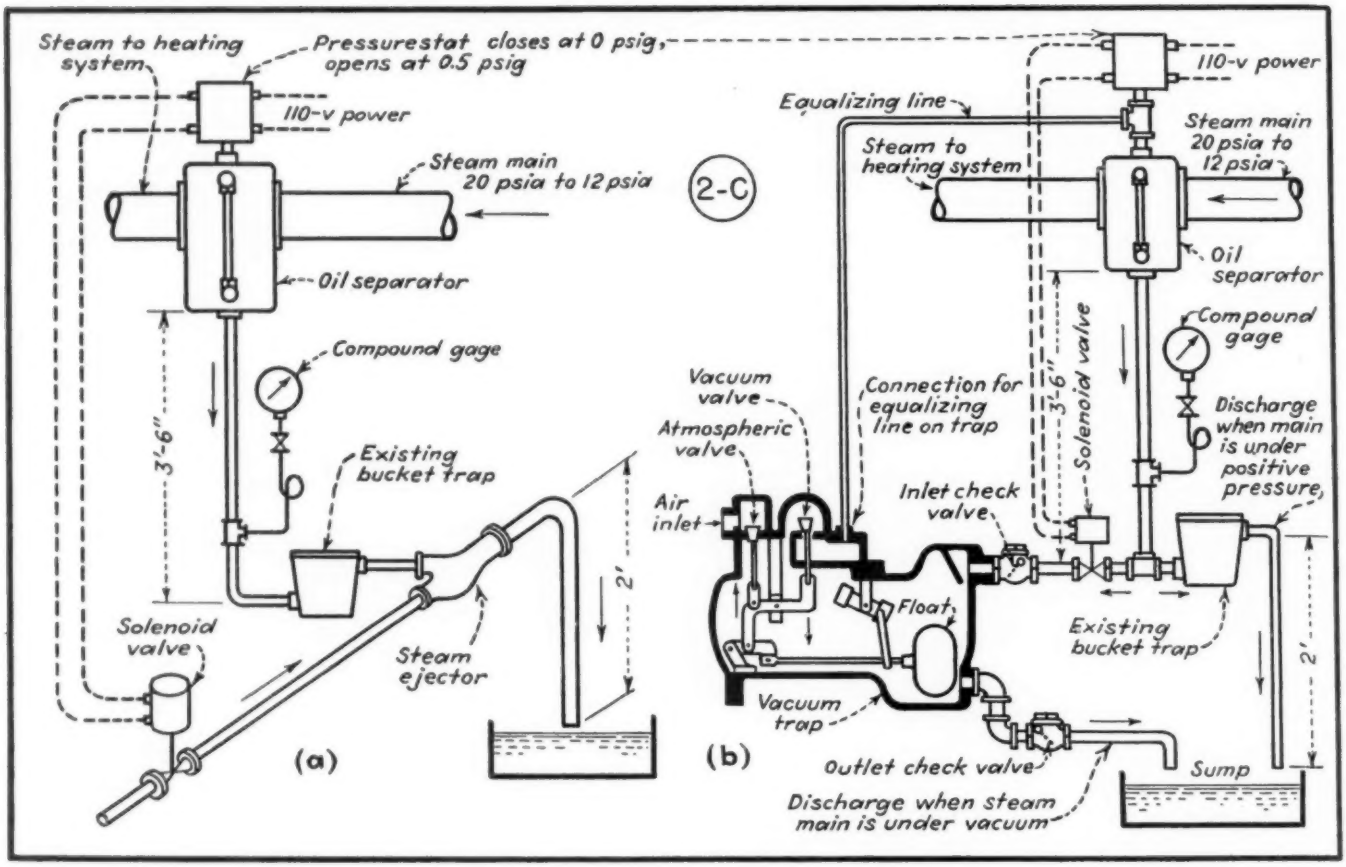
If it is desirable to admit some live steam into the heating system a reducing valve can be installed as in sketch 2-*A*. In this way pressure greater than atmosphere can be maintained when there is not enough exhaust steam from the engine.

Another way to make the trap work without installing a reducing valve is to install a valve downstream from the oil separator. When there is not enough exhaust steam to maintain a pressure above atmosphere this valve should be throttled until the gage shows a slight pressure.

Finally, if *EEL* wants a different type of trap, I suggest a vacuum trap. I have seen installations of this kind that drain oil separators in the exhaust steam lines of condensing engines, and they work very satisfactorily.

St. Louis, Mo. E E SCHELLENBERG

(*Continued on page* 112)

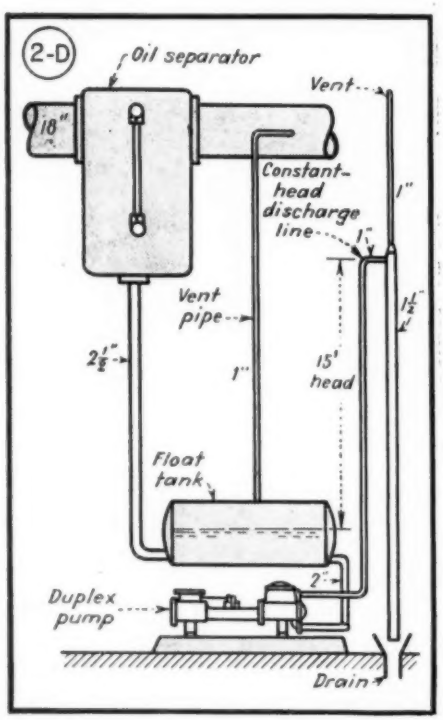


Steam Ejector Aids Bucket-Trap Operation

THE ORDINARY BUCKET TRAP in *EEL's* problem does not function when the pressure in the line is below atmospheric; therefore, the oil and condensate build up in the separator and are swept along by the steam into the heating system. Furthermore, if this bucket trap is not equipped with an internal check valve, air is drawn through the trap and up into the main. This, of course, decreases the heating system's efficiency.

The system can be made to work as at (*a*), sketch 2-*C*. When the steam main pressure drops from 20 psia to 14.7 the pressurestat closes the circuit, energizes the solenoid valve, which starts the ejector. This creates suction at the trap discharge and the trap functions. When the pressure in the steam main builds up to 15.2 psia, the pressurstat opens the circuit, closes the solenoid valve and the trap continues to function under the positive pressure. This scheme insures automatic operation under positive and subatmospheric pressures. If manual operation is desired, the pressurestat and the solenoid valve may be removed. The solenoid valve should be replaced by a manual shutoff valve. Either of these schemes is quite economical and should give satisfactory service. A more elaborate system is shown at (*b*) in the sketch. Here the pressurestat and the solenoid valve function in the same manner as above and give complete automatic operation. The addition of the vacuum trap is a rather expensive feature, but it has the advantage of eliminating an outside pressure medium that has to be employed with the ejector.

Elmhurst, N. Y. J P MURTAGH



Small Pump Removes Oil

UNDER THE CONDITION EEL describes, where steam pressure varies from 12 to 20 psia, ordinary steam traps do not meet the requirement. The power that causes the trap to function is derived from higher pressure in the trap body than the pressure against which it is discharging.

One of the best methods to remove oil or water from a trap operating below atmospheric is to use a small duplex pump and float tank as in sketch 2-*D*. This equipment removes drainage from the separator over the entire pressure range. To prevent steam blowing through the pump, when the pressure is above atmospheric, discharge of the pump is piped to give a static head of 14 to 15 ft. The pump selected must be equipped with metal valves and packed with rubber-free packing. It is necessary to provide a vent line from top of float tank to center of exhaust line. This prevents air binding of the float tank.

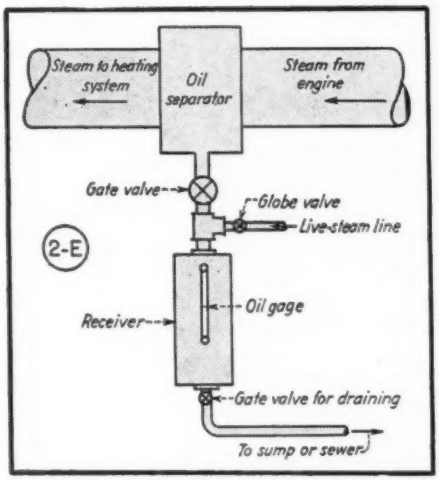
Buffalo, N. Y. S C PAGE

Collect Oil in Receiver

THE REASON EEL's trap does not work when the system is operating at a vacuum is that a bucket-type trap requires a force to dispose of the condensate in the trap. I suggest *EEL* discard the bucket trap and install layout in sketch 2-*E*.

Have the oil drain from the separator into the cylinder shown. In operation, the live-steam and blowoff valves are closed and the gate valve from the separator is opened wide. As oil is separated from steam, it drains and collects in the cylinder. A gage glass shows when to blow out the oil collected.

Newark, N. J. R C CONK



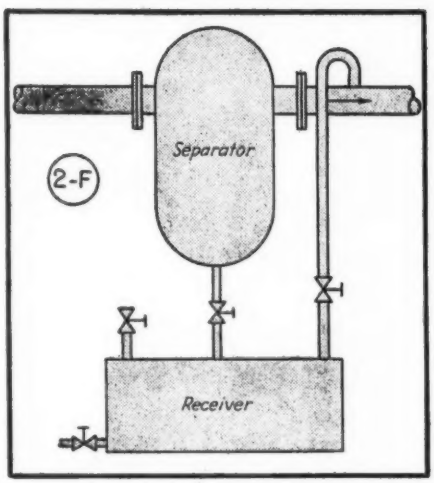
Try Manual Operation

EEL's TRAP is an automatic valve, which opens when filled with a liquid, but its construction is such that pressure is required to blow the liquid out of the trap into the atmosphere. Hence when there is no pressure the trap does not operate.

If a receiver were installed at the bottom of the separator, sketch 2-*F*, it would drain the separator either under pressure or vacuum. But it would be necessary to close the valves between the piping system and the receiver, and to open the vent and drain valves to drain the receiver when the system is operating at pressures below atmospheric.

If this entails too much attention, a float-operated vacuum pump and receiver will do the job nicely.

Piney Woods, Va. I A BUTCHER



Install Return Trap

A SOLUTION TO EEL'S PROBLEM is shown in sketch 2-*G*. By using a return trap installed level and plumb, the system can be made to work. This arrangement is necessary because his system is working above and below atmospheric pressure. The vacuum developed in the heating system is the reason a return trap is essential. Install pipe *B* to a point near the ceiling. Pipe *A* should be about 6 ft long. Steam line to trap is shown at pipe *C*. *EEL's* existing bucket trap will work as shown although a float thermostatic type is usually installed.

Mount Dennis, Ont. C R DAY

Break Vacuum Through Check Valve in Line

THE REASON EEL'S TRAP does not function at the time the vacuum is on the system is that vacuum in the oil separator holds the oil back in the trap.

To correct this, install a check valve in a vertical position in the drain line leading from the oil separator to the trap, as in sketch 2-*H*.

Whenever vacuum is present in this line, the check valve opens and admits just enough air to break the vacuum, but when pressure is on the line the check remains closed.

Check valve, installed vertically, eliminates dripping condensate.

Boston, Mass. H W BRANDT

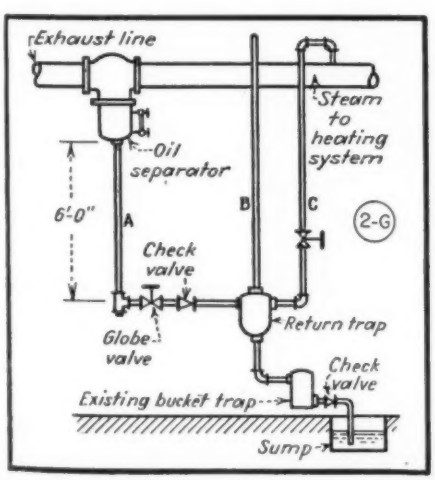
Vacuum Trap Works Best

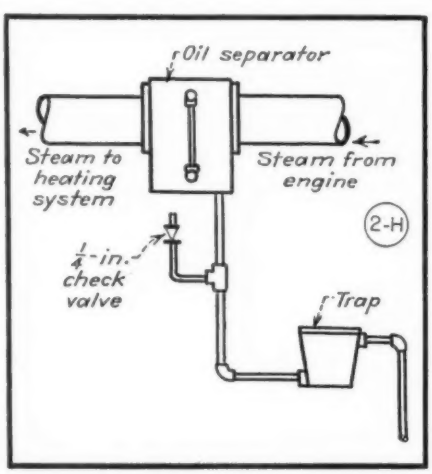
EEL IS USING a bucket-type trap to drain his separator. As long as there is pressure on the steam line to the heating system this bucket trap will operate automatically without giving trouble.

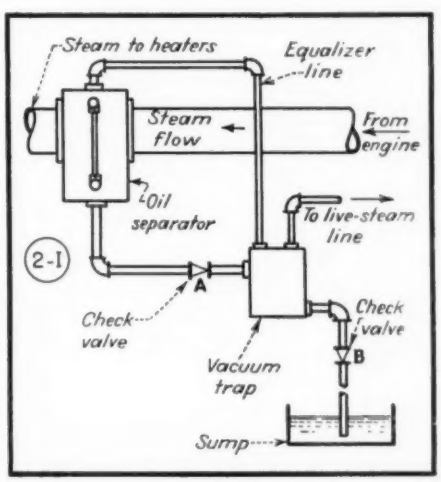
Sketch 2-*I* shows a vacuum trap instead of a bucket type There is a check valve *A* on the inlet side of the trap and another, *B*, on the outlet side. There is an equalizer line from top of trap to top of oil separator. Also a live-steam line is connected to the trap. Operation is as follows: Under a vacuum the oil and condensed steam flow through check valve *A* into the trap. The float on inside of trap controls a valve on the equalizer line and also a valve on the live-steam line. As the trap fills up, the float suddenly closes the valve in the equalizer line and opens the live-steam line. Check valve *A* closes and *B* opens, and the contents of the trap are discharged. After discharge the trap restores itself.

Wilmington, N. C. G G AVANT

(*Continued on page* 142)







CENTRIFUGAL PUMP Q&A FOR POWER ENGINEERS

By I J Karassik and Roy Carter

17—Maintenance and Inspection

Seventeenth in a monthly series by Igor J Karassik and Roy Carter, Worthington application engineers. These two experts on centrifugal pumps have selected questions and answers that give a broad, practical understanding of the pumps, their construction, operation, characteristics, troubles and remedies.

Q 1—Can specific rules be laid down for the maintenance of all designs of centrifugal pumps?

A—Comments here are restricted to maintenance of designs most commonly used, because of the wide range in types and sizes, as well as differences in materials of parts. Opinion varies considerably on good practice in rebuilding worn parts such as wearing rings and sleeves. But as far as possible procedures that have been successful are mentioned even though some of them are not fully accepted as good practice. Naturally, the manufacturer's instructions should be studied carefully before attempting to operate or service any pump, particularly a specially designed unit.

Q 2—What maintenance and inspection should be made semiannually?

A—Check for free movement of the stuffing-box gland, clean and oil the gland bolts and nuts, and inspect packing to see whether it should be replaced. Check pump and driver alignment, and correct if necessary. Drain and refill oil-lubricated bearings. Check grease-lubricated bearings for suitable consistency and correct amount of grease.

Q 3—What maintenance and inspection should be made annually?

A—Thoroughly inspect a unit once a year. Remove bearings, clean and examine for flaws and clean bearing housings. After cleaning antifriction bearings examine them for scratches and wear; do not let dirt or moisture get into them and immediately after inspection, coat with a neutral oil or grease.

Remove packing and examine the wear in the shaft sleeves or, if no sleeves are used, in the shaft.

Disconnect coupling halves and check alignment. With packing removed and coupling disconnected from horizontal pumps with babbitt bearings, check vertical movement at both ends of shaft. Vertical movement of over 150% of the original requires investigation to determine the cause. Check bearing end play and if it exceeds the manufacturer's recommended amount determine the cause and correct.

Check and flush drain, sealing-water and cooling-water piping. Repack stuffing boxes.

Recalibrate instrument and metering devices, if used, and test pump performance. If internal repairs are made, test pump after their completion.

Q 4—How often should grease-lubricated ball bearings be inspected and greased?

A—Even when a pump is operating 24 hr a day, a lubrication check every three months is ample. Because too much grease causes more harm than not enough, do not allow an inexperienced operator to add grease to ball bearings. Generally, it is recommended not to fill the bearing housings more than one-third full of grease.

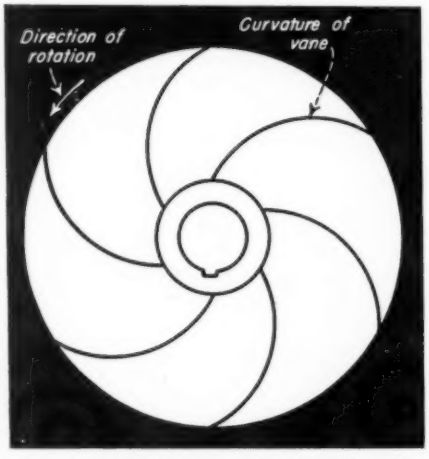


Fig. 1—Impeller rotates in direction away from vane curvature as shown

Q 5—How should grease be added to a pump's bearing housing?

A—Remove the drain plug from bearing-housing bottom, then with the pump running, add a small amount of grease. To renew completely, add grease until the new can be seen at the drain outlet. Allow excess grease in the housing to leak from the drain for 10 to 15 min, when the grease will have approached operating temperature and the excess will have stopped flowing. Then replace drain plug.

Q 6—How much should packing glands be tightened?

A—It is customary to start the pump with stuffing-box glands loose and water from the pump, or seal cage if one is used, flowing along the shaft. Then gradually tighten the glands until the leakage almost stops. If the gland is tightened too much and leakage stops, the packing will heat, expand and burn, and possibly score the shaft or shaft sleeve.

Q 7—Is it good practice to add one or two new rings of packing to old?

A—This depends on the kind of packing. Do not add new packing if it will compress the old to where the water seal cage is displaced and plug the sealing-liquid opening. It is generally recommended that old packing be replaced completely.

Q 8—How should a stuffing box be repacked?

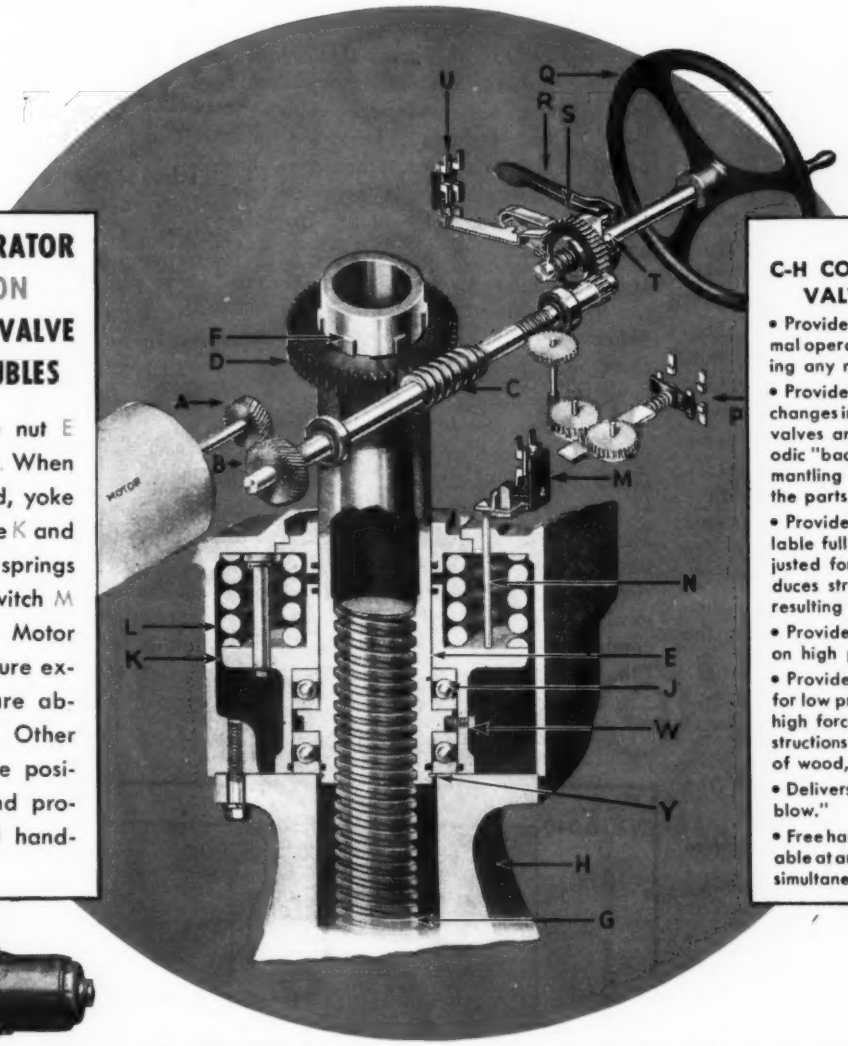
A—(a) Remove all old packing and

(*Continued on page* 116)

BETTER SEATING ARRANGEMENTS

FOR ALL VALVES

OR... HOW TO GET TIGHT SEATING WITHOUT JAMMING



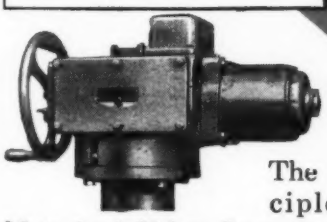
THE VALVE OPERATOR CONSTRUCTION THAT PREVENTS VALVE JAMMING TROUBLES

Motor drives yoke nut E thru A, B, C, D and F. When valve disc is seated, yoke nut rises, lifting plate K and rod N, compressing springs L and operating switch M which stops motor. Motor drift, and temperature expansion of stem, are absorbed in springs. Other elements shown are position limit switch and provision for optional hand-wheel operation.

Features of

C-H CONTROLLED THRUST VALVE OPERATORS

- Provides tight closure under normal operating conditions, eliminating any need for "final" seating.
- Provides for large temperature changes in high temperature steam valves and gas valves. No periodic "back off" necessary. No dismantling of valve to "unfreeze" the parts.
- Provides for accurately controllable full power drive, easily adjusted for service conditions. Reduces strain and wear and tear resulting from other systems.
- Provides high speed operation on high pressure valves as well.
- Provides ADEQUATE Protection for low pressure valves . . . against high forces, against artificial obstructions such as gravel, a piece of wood, etc., in the valve.
- Delivers an unseating "hammer blow."
- Free hand-wheel operation available at any time. Protected against simultaneous electrical operation.



The Controlled Thrust principle of Cutler-Hammer Motorized Valve Operators for all kinds of valves provides the following advantages:

It *always* assures a tightly seated valve regardless of the frictional condition of the valve stem or the driving mechanism.

It *definitely* prevents damage to a valve from the expansion and contraction of valve parts under extremes of temperature.

It *unfailingly* provides correct seating no matter how swiftly the valve is closed.

On water lines, it prevents damage in case foreign matter such as gravel lodges in the valve.

Cutler-Hammer *Controlled Thrust* Valve Operators gain their superiority through what may be called a transferable fulcrum. They drive through a yoke nut fulcrum established by heavy steel springs whose compression is equal to the desired tight seating pressure. When the valve is accurately seated, the *seat* becomes the fulcrum, the yoke nut retracts, opening the motor circuit, and motor drift is absorbed by the springs. Moreover, the same accurate seating is maintained as valve parts expand and contract.

Now is the time to investigate this proven superior motorized valve operator for your plant. Available as standard equipment on all leading makes of valves. . . . CUTLER-HAMMER, Inc., 1209 St. Paul Ave., Milwaukee 1, Wis.

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PUMP Q&A

Continued

clean the stuffing box. (b) Make sure the packing is suitable for the service. (c) Insert each ring separately, pushing it as far into the stuffing box as possible, and seating it firmly. (d) Stagger successive rings so joints are 90 or 180 deg apart. (e) If a water seal cage is used, locate it directly under the sealing-liquid connection and be sure successive packing rings do not displace it. (f) After the required number of rings have been inserted, install glands and tighten gland nuts firmly; then back off nuts until gland is loose. (g) New packing generally has to be run in. It is good practice to start and stop the pump several times, at 1- or 2-min intervals, until stuffing box runs cool with continuous operation. When driven by a steam turbine, run pump at slow speed to achieve the same effect. (h) Allow stuffing box to have a slight leakage to lubricate the packing. Never tighten the gland until there is no leakage.

Q 9—When remounting impellers, especially in multistage pumps, how is proper rotation direction insured?

A—Impellers revolve away from the curvature of their vanes, Fig. 1.

Q 10—How frequently is a complete overhaul necessary?

A—This depends on how many hours a pump operates each day, materials of which it is constructed, its design, and general, normal care and kind of liquid handled. Some severe service may need complete overhaul monthly; others, only every two or three years, or less often. Therefore, experience largely determines frequency of complete overhaul.

Q 11—What should be done to the pump casing during a complete overhaul?

A—On a general-service pump, thoroughly clean and repaint the casing water ways. If casing is pitted or eroded this can often be corrected by welding, brazing or metal spraying, depending on material from which the casing is made and the facilities available for repair.

Q 12—Can shaft sleeves be reconditioned?

A—Yes, they are often built up by welding or metal spraying, and grinding. It is good practice, after tightening the sleeve in place, to check concentricity on the shaft. Pump size, sleeve material and facilities available for repair work determine whether it is more economical to install new sleeves or resurface old ones.

Q 13—How much wear is permissible in sleeve bearings before they require rebabbitting?

A—Do not allow clearance between the shaft and a babbitt bearing bushing to exceed 150% of the original clearance. Bearing bushings are usually rebabbitted by pouring with an undersized shaft centered in the bushing. They are then bored to size to reduce scraping to correct clearance. Babbitt bearings are sometimes restored by metal spraying and reboring.

Q 14—How much wear is permissible in the wearing-ring clearances between impeller hub and casing-ring bore before these parts need to be renewed?

A—Theoretically, this depends on many factors, but in general with water pumps, an increase of 0.01 to 0.015 in. in diametral clearance warrants renewal of the wearing surface. The clearances, Fig. 2, are basically for single-stage pumps with single- or double-flat wearing rings if made of materials that do not easily gall. They, therefore, apply to combinations of: bronze with a dissimilar bronze, cast iron with bronze, steel with bronze, monel metal with bronze, and cast iron with cast iron. For 2- and 3-stage single-casing pumps make wearing-ring diametral clearance 0.002 in. larger than given in Fig. 2, and for 6- to 8-stage single-casing pumps increase wearing-ring diametral clearance 0.003 in.

As an example, assume a single-stage pump that has casing and impeller wearing rings of nongalling materials with a leakage joint 9 in. in diameter. A leakage joint of this diameter requires 0.018-in. clearance, point *A*, with 0.003 in. plus tolerance permitted, point *B*, Fig. 2. Correct machining dimensions for the inside diameter of the casing ring are between 9 in. and 9 + 0.003 = 9.003 in.

The impeller-hub-ring diameter should equal inside diameter of casing ring 9 in., minus clearance 0.018 in. or 9 − 0.018 = 8.982 in. Tolerance of this ring is also 0.003 in., but minus, so that its outside diameter can be 8.982 − 0.003 = 8.979 in. Actual diametral clearance can be between 9 − 8.982 = 0.018 in. and 9.003 − 8.979 = 0.024 in. For multistage pumps, wearing-ring clearance is increased as indicated above. Tolerances in Fig. 2 are always plus when applied to casing wearing rings, and minus for impeller wearing rings.

(*Continued on page* 118)

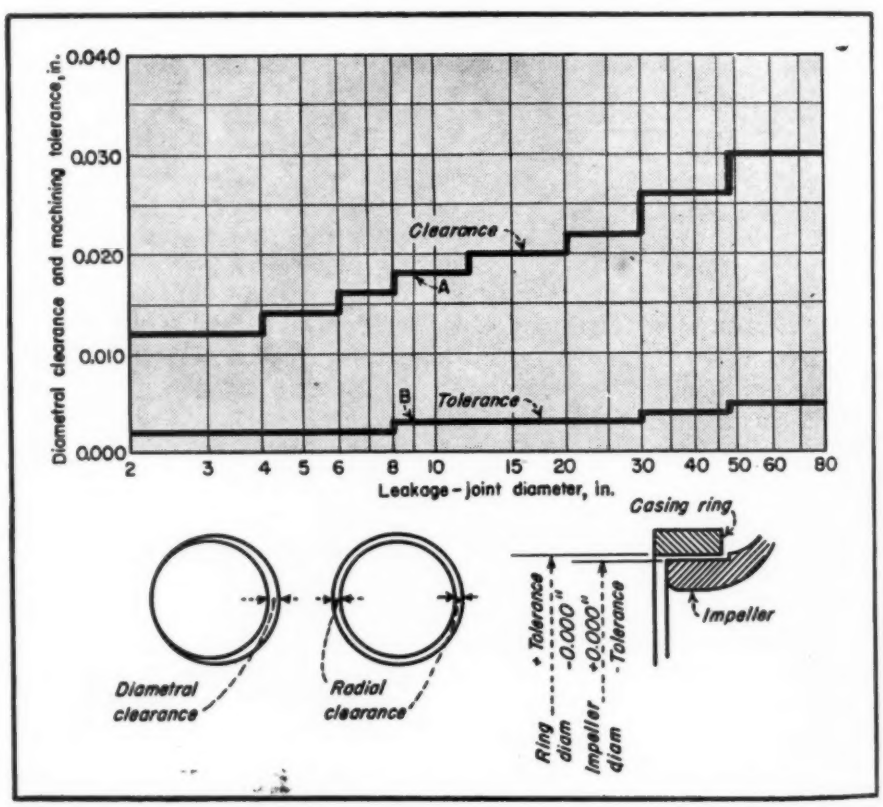
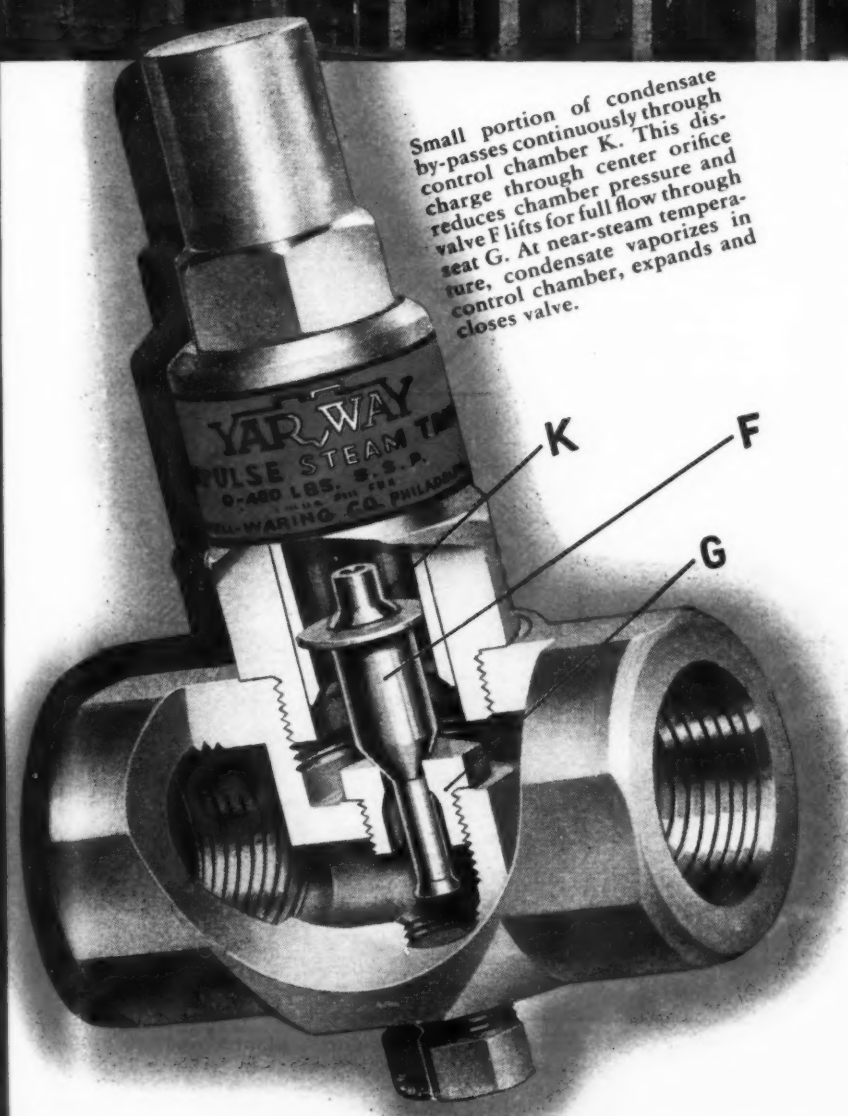


Fig. 2—Clearance chart for flat wearing rings in single-stage centrifugal pump with single, double-flat or L-shaped rings of materials that do not easily gall

Six LITTLE TRAPS and How They Work!



Small portion of condensate by-passes continuously through control chamber K. This discharge through center orifice reduces chamber pressure and valve F lifts for full flow through seat G. At near-steam temperature, condensate vaporizes in control chamber, expands and closes valve.

Six Yarway Impulse Steam Traps—doing a big job draining condensate from a battery of autoclaves used for experimental extraction of tanning materials. They are typical of the two hundred Yarway Traps installed on a variety of steam equipment at the big Eastern Regional Research Laboratory of the United States Department of Agriculture.

Why were Yarways selected for this important work? For the same reason that over 450,000 Yarways have been bought in less than 10 years for use throughout all industry. *They get steam equipment hotter, sooner . . . and keep it hot.*

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See your nearest Mill Supply dealer, or write for Bulletin T-1739.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Yarway Traps are also made and sold in Canada

YARWAY IMPULSE STEAM TRAP

PUMP Q&A

Continued

Q 15—How is wearing-ring clearance restored in a pump that has a single flat or L-shaped casing ring, Fig. 3?

A—There are three methods: (a) Obtain from the manufacturer a new casing wearing ring bored undersize, and true up the impeller-hub wearing ring by turning down in a lathe. (b) Build up the worn casing-wearing-ring surface by welding or metal spraying so that it can be bored undersize, and true up the impeller-hub wearing ring, as in (a). (c) True up the casing wearing ring by boring oversize, build up the impeller-hub wearing ring and machine to give correct clearance with casing rebored ring.

Generally, method (a) is best. Methods (b) and (c) are difficult, and are feasible only if a pump is large and equipment to do the work is available on the premises. Usually building up the impeller-hub wearing ring by welding is difficult and, if the wearing surfaces are to be restored, a pump with double-ring construction is preferred.

Q 16—How is the wearing-ring clearance restored in a pump with double flat or L-type wearing rings, Fig. 4?

A—Several methods can be used: (a) Obtain new oversized impeller ring and use old casing ring bored to larger diameter. (b) Obtain new casing ring bored undersize, and use old impeller ring turned down to a smaller diameter. (c) Renew both casing and impeller rings if necessary. (d) Build up either the casing or impeller ring by welding or metal spraying; then machine the other. By altering the ring build-up, the original leakage-joint diameter can be closely maintained. (Comments in answer to Q 15 apply here also.)

Q 17—How is clearance restored in worn labyrinth wearing rings, Fig. 5?

A—Labyrinth rings are generally double with the impeller ring screwed on the impeller. If excessive clearance develops, replacement of the rings is usually advisable.

Q 18—What precautions should be taken when a new wearing ring is mounted on an impeller?

A—When a new wearing ring is put on an impeller, its surface is often not concentric with the shaft. Therefore after mounting a new ring, check its wearing surface, and machine if necessary. This should be done whether the ring is pressed on, bolted on, or screwed on the impeller.

Q 19—Is it feasible to repair a pitted or eroded impeller?

A—When large impellers are pitted or eroded, they are commonly repaired by welding or metal spraying. Often the increased cost of special alloy metal for impellers is warranted. When cavitation causes pitting, ask the pump manufacturer whether an impeller more suitable for the suction conditions can be obtained.

Q 20—How is an impeller mechanically balanced?

A—To balance by hand, an impeller is pressed on an arbor, the ends of which are placed on two parallel and level knife edges. If out of balance the impeller will turn and come to rest with the heavy side down. Metal must be removed from that side to put the impeller in balance. This must be done, however, without impairing pump performance or accelerating erosion. For that reason, drilling holes in the heavy side is undesirable.

It is best practice to mount a shrouded impeller off center in a lathe and take a cut from the shroud, deepest at the periphery, as in Fig. 6. This may be done on one or both shrouds depending on their thicknesses and amount of metal to be removed.

In semiopen-impeller pumps, remove metal from the shroud if the design permits or from the under part of the vanes if those on the heavy side are thicker than the others. This latter method is used on open impellers.

Q 21—What is the main function of a pump serial number?

A—The number identifies the pump so its manufacturer can supply repair parts of correct size and materials. Most centrifugal pumps are of standard designs in which, for each casing size, any one of several impeller sizes and designs may be used. Lacking an identification number, the pump manufacturer would be at a loss to furnish correct repair parts even though pump size and type might be known.

Q 22—What precautions are necessary in preparing a centrifugal pump for extended storage?

A—Thoroughly dry the pump internally with hot air, and preferably fill or coat with a light moisture-free protective, such as oil or kerosene. Remove all packing, as it may contain moisture or corrosive agents. Remove the bearings, coat them with vaseline or grease, then wrap, tag and store. If removal of bearings is not desirable, protect them properly from corrosion and dirt. Dismantle all readily accessible parts, including couplings; dry and coat them with vaseline or heavy oil. Remove wet-pit pumps from their setting, take them apart and after proper preparation and tagging, store all parts in a suitable place.

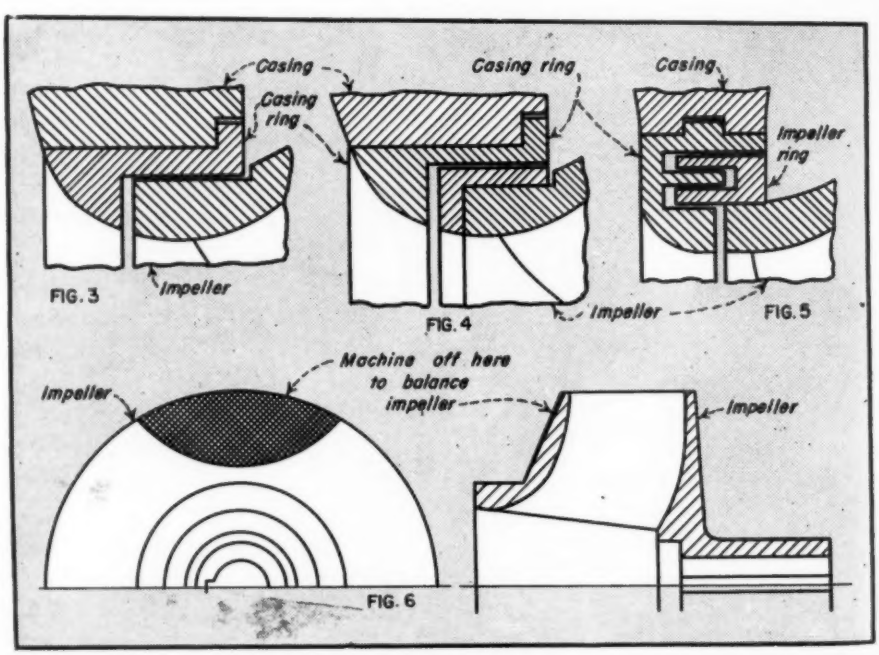

Fig. 3—L-shaped casing wearing ring. Fig. 4—Double L-shaped wearing rings. Fig. 5—Labyrinth wearing rings. Fig. 6—Machine off metal to balance impeller

All Clear AFTER 9,000 HOURS

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Keeps Rings Free in Big Diesels for More than One Year of Continuous Operation

More than a year of continuous running, day and night . . . no stuck rings . . . no heavy sludge . . . no hard carbon . . . that's the record of a "Job-Proved" Sun Diesel lubricant in a big industrial power house.

The picture above shows a piston from one of the company's two 750-h.p., 6-cylinder, 4-cycle, Worthington Diesels after 9,000 hours of operation. The engine was shut down at this time only for routine inspection.

Performance like this is typical of the results being obtained by hundreds of Diesel operators in plants throughout the country, and in all types and sizes of Diesel.

Sun Diesel Lubricants have proved their ability on the job. They have extremely high resistance to heat, with minimum tendency to form gum or hard carbon. For continuous power output and low maintenance costs, call the Sun office near you today.

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INDUSTRIAL PRODUCTS

REFRIGERATION NOTEBOOK — 29

Adding Ammonia to A Refrigerating Plant

By TERRY MITCHELL, ME, *Frick Company*

► To charge a refrigerating system, connect a drum of ammonia to the charging connection, pump all air from the system (including the charging pipe) and admit enough ammonia to create a pressure of 20 or 25 psi. Lay the ammonia drum on the floor with the bottom end blocked up so the opening of the bent tube, inside, is submerged in the liquid. The drum valve-stem packing nut has a left-hand thread to keep it from becoming loose when the valve is opened. Valves on some of the older drums have to be rotated several turns before liquid begins to flow. Be sure to wear gloves, and have a bucket of water and an ammonia mask nearby, when handling refrigerant.

After testing for leaks with burning sulphur tapers, admit enough ammonia to put the system under about 100-psi pressure. Then close the bypass valves and crankcase pumpout, turn on condenser and jacket cooling water, start the compressor, and operate the plant, feeding ammonia through the expansion valve to maintain a suction pressure of 15 to 20 psi.

Watch the receiver: close the charging valve when gage glass shows half full. If you allow it to get too full, the head pressure will rise rapidly and dangerously. It is better, and much easier, to add ammonia than to remove an oversupply from the system. Keep the drum connected while cooling the rooms or tanks and feed additional ammonia as needed. As the drum becomes nearly empty, white frost appears on its bottom. After it has been drained as well as possible under the available suction pressure close the charging valve and needle valve on the drum and connect a full drum in its place.

STARTUP CHECKS

As the plant gets into regular operation, look over the bearings, cylinders, oil pumps, gages, thermometers and other devices at frequent intervals for signs of heating or other trouble. Adjust pressure-gage valves to keep the pointers or hands from vibrating excessively. Be doubly sure the machine has enough oil in the crankcase: An extra inch or two is recommended for the first week of operation. Change the oil each week for the first month. Then open the crankcase and clean it before putting in fresh oil.

At the same time, remove the safety heads and inspect the cylinder valves. If discharge valves are dry and appear *burned*, the cylinders are not getting enough oil. Be careful to release the pressure under the safety heads by momentarily opening bypass valve *CC* and later removing plug *P*, before taking off the safety heads. Proceed slowly, and guard the eyes, when unscrewing the plug, or when opening any of the cover plates or valve bonnets, if ammonia pressure is inside. Test the automatic controls and safety cutouts, and adjust the float or expansion valves to balance the load; then put the system on automatic operation.

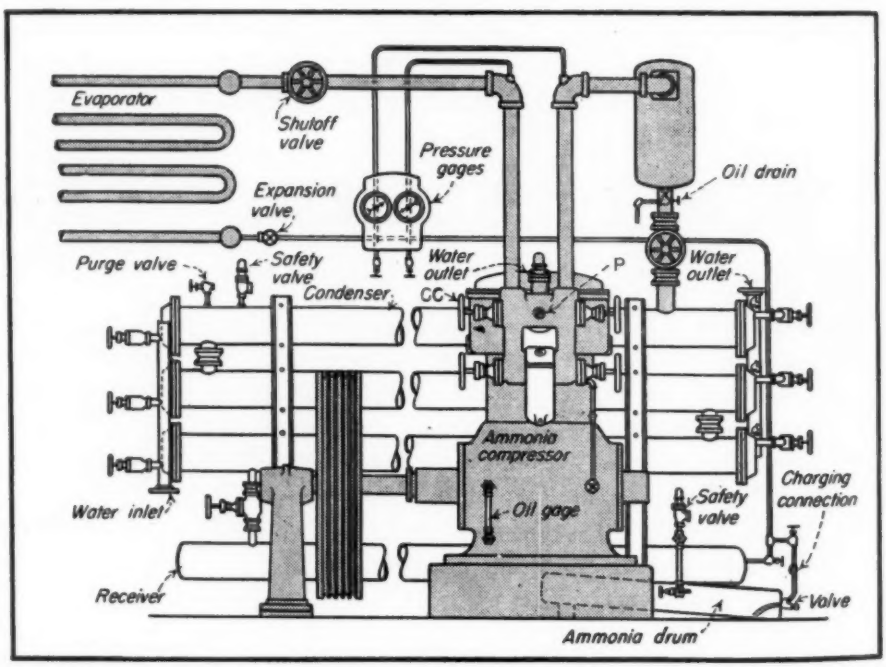
Under normal running conditions the receiver will be from one fourth to one half full of liquid ammonia. The main liquid valve commonly called the *king* valve, has a long threaded nipple extending into the receiver far enough to be under the liquid surface even when the vessel is nearly empty. Have this valve wide open when the plant is running, but crack the expansion valve open a part of a turn—just enough to keep the suction pressure at the point desired, and to keep frost from accumulating along the suction line back to the compressor cylinders. Frost on the suction trap does no harm.

STARTING AND STOPPING

Usual starting procedure is: (1) Turn on cooling water. (2) Open compressor discharge valve. (3) Start compressor. (4) Open compressor suction valve slightly until evaporator pressure is pumped down to about 20 psi; then open it wide. (5) Open liquid valve and adjust the expansion valve to give the desired suction pressure.

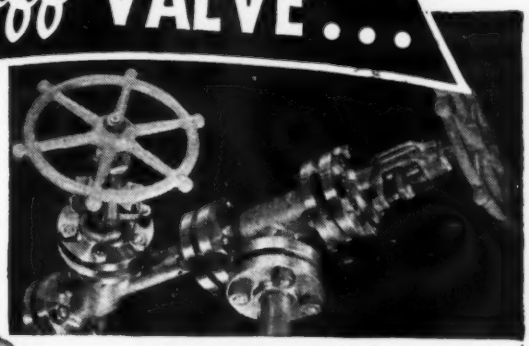
When shutting down: (1) Close liquid valve. (2) Close suction valve. (3) Shut down the compressor. (4) Close compressor discharge valve. (5) Shut off cooling water to the equipment.

First article on starting refrigerating plants appeared in April.—Editor



In adding ammonia be sure not to overfill the receiver. It is easier to add a small quantity at a time than to remove an oversupply after it is in the system

How to buy a *Blow-off* VALVE . . .



FIT ANY SPACE. Edward steel blow-off valves are built in both straightway and angle design, offering a variety of hookups to fit installation space needs.

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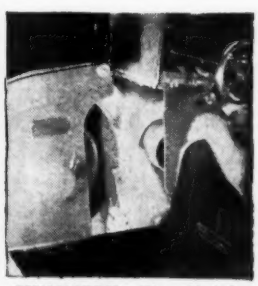

SYMMETRY. Fine-finish, perfect symmetry of EValloy stems is achieved by centerless grinding.

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WELDING ENDS. Socket welding ends, as well as flanged ends, are available in Edward blow-off valves.

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5 Bonnet. Forged steel, integral yoke post design to prevent misalignment.

6 Packing. Die formed temperature resisting EValpak.

7 Junk Ring. Accurately fitted to stuffing box.

8 Cooling Chamber. Large condensate chamber to protect packing.

9 Studs and Nuts. Through bolted joint makes disassembly simple.

10 Disk Nut. Heavy steel with backseating surface for repacking under pressure.

11 Body. Streamlined steel body with no unnecessary parts to clog or erode.

12 Disk. EValloy stainless steel or Stellite hard facing, precision borized with mating seat.

13 Seat. EValloy or integral Stellite seat, mated with disk.

Built in three pressure classes—300 lb., 600 lb. and 900-1500 lb. sp.

Edward Valves, Inc.

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MATH TIPS

PHIL SWAIN GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS

⑭—Logs for Powers and Roots

▶ FUNDAMENTALS OF LOGARITHMS and the use of logs to multiply and divide have been explained in three preceding issues of POWER: April, page 120; May, page 120; June, page 122.

Logs are especially useful in finding powers and roots of numbers, particularly odd POWERS April, page 120; May, page 120; and June, page 122.

Suppose we want to square 2.345. That is merely the product of 2.345 and 2.345, so we add the logs thus:

Number	*Log*
2.345	0.3702
2.345	0.3702
Sum	0.7404, log of 5.500

So the square of 2.345, to the accuracy of our 4-place log tables, is 5.500.

Again, the cube of 2.345 would be 2.345x2.345x2.345, and we could proceed to add up the three logs. However it's easier just to multiply by 3 like this:
Log $2.345^3 = 3 \times \log 2.345 = 3 \times 0.3702 = 1.1106$. This is log of 12.9, so $2.345^3 = 12.9$.

Now it is true that the log of *any* number to *any* power is merely the index of the power multiplied by the number's log. This holds even where the power is not a whole number, and it brings us to a class of problems where logs are essential—where there is no other way to get the answer.

Example: When air is compressed or expanded in a cylinder without friction, and without transferring heat to or from the cylinder walls, the ratio of absolute pressures equals the volume ratio raised to the 1.4 power.

Consider the case of a perfect compressor in which the volume at start of compression is five times the volume at end of compression. What is the final absolute pressure?

Since the volume ratio is 5, the pressure ratio is $5^{1.4}$, that is 5 to the 1.4 power. Log 5 is 0.6990. Then 1.4x0.6990 = 0.9786, the log of 9.52. This means that final absolute pressure is 9.52x14.7, where 14.7 psi is absolute pressure of the atmosphere. Final pressure is 139.9 psi abs, or 125.2 psi gage.

Getting roots is just as easy. Divide the log of the number by the index of the root to get the log of the root.

Problem: What is the fifth root of 17.06? Log 17.06 is 1.2320. This divided by 5 is 0.2464, which is log of 1.764. Therefore the fifth power of 17.06 is 1.764.

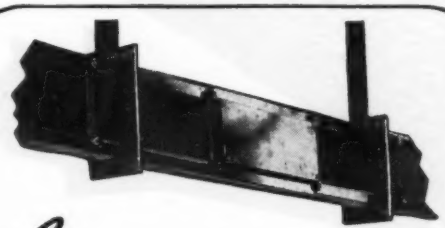
Four-place Common Logarithms of Numbers

No.	0	1	2	3	4	5	6	7	8	9	Ave. diff.
1.0	0.0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	42
1.1	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	38
1.2	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	35
1.3	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	32
1.4	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	30
1.5	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	28
1.6	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	26
1.7	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	25
1.8	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	23
1.9	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	22
2.0	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	21
2.1	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	20
2.2	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	19
2.3	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	18
2.4	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	17
2.5	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	
2.6	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	16
2.7	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	
2.8	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	15
2.9	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	
3.0	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	14
3.1	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	
3.2	5052	5065	5079	5092	5105	5119	5132	5145	5159	5172	13
3.3	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	
3.4	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	
3.5	5441	5453	5465	5478	5490	5502	5515	5527	5539	5551	12
3.6	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	
3.7	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	
3.8	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	11
3.9	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	
4.0	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	
4.1	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	10
4.2	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	
4.3	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	
4.4	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	
4.5	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	
4.6	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	
4.7	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	9
4.8	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	
4.9	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	
5.0	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	9
5.1	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	8
5.2	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	
5.3	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	
5.4	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	

No.	0	1	2	3	4	5	6	7	8	9	Ave. diff.
5.5	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	
5.6	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	
5.7	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	
5.8	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	7
5.9	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	
6.0	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	
6.1	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	
6.2	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	
6.3	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	
6.4	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	
6.5	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	
6.6	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	
6.7	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	6
6.8	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	
6.9	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	
7.0	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	
7.1	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	
7.2	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	
7.3	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	
7.4	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	
7.5	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	
7.6	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	
7.7	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	
7.8	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	
7.9	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	5
8.0	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	
8.1	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	
8.2	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	
8.3	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	
8.4	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	
8.5	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	
8.6	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	
8.7	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	
8.8	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	
8.9	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	
9.0	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	
9.1	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	
9.2	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	
9.3	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	
9.4	9731	9736	9741	9745	9750	9754	9759	9764	9768	9773	
9.5	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	
9.6	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	4
9.7	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	
9.8	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	
9.9	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	

Consider these important facts...

...when you're deciding which Duct for your plant!



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SAFLEX PLUG-IN DUCT... Running Mate for Saflex Feeder Duct

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All Feeder and Plug-In Duct is *NOT* pretty much alike...

Performance, not Original Cost, is the prime factor in buying the right duct...

You have a right to expect the duct you buy to pay its own way in terms of the flexibility and increased efficiency it provides. Any good duct will do that. But a careful inspection of SAFLEX DUCT will prove that there's a vast difference in the *degree* of efficiency.

Any duct installation represents a fairly substantial investment . . . substantial enough to justify a thorough comparison before purchase. We not only welcome such a comparison—we urge it.

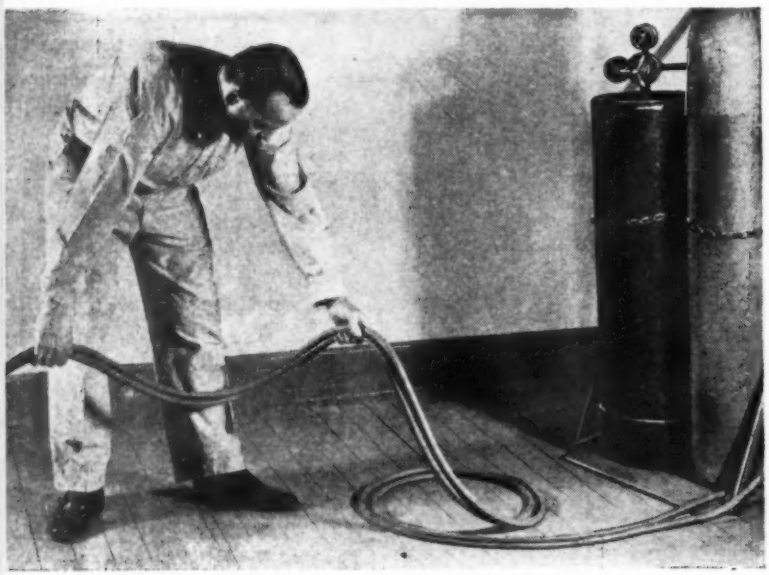
SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

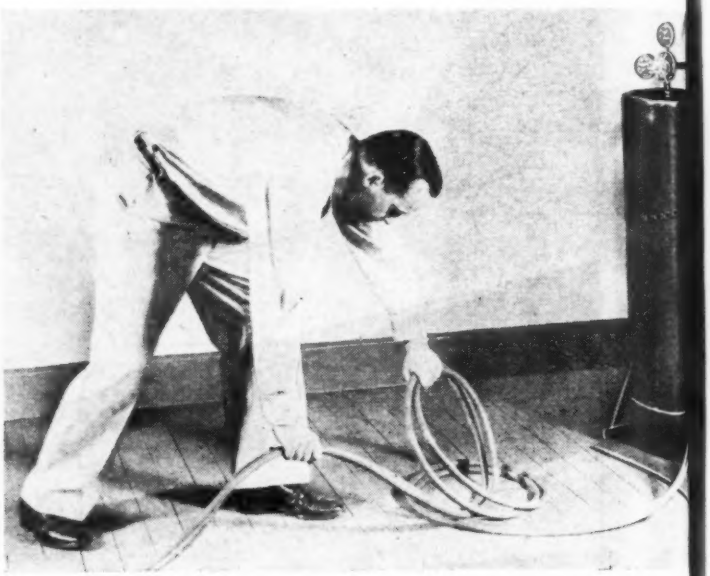
HOW TO COIL WELDING HOSE TO PREVENT KINKS

► BLOWPIPE AND CUTTING-TORCH HOSE is specially made and colored for easy identification; for oxygen it is green, and for acetylene red. Hose must be of good quality rubber, have sufficient number of plies of fabric to withstand the gas pressure, and be sturdy enough to resist abrasion from being constantly dragged over rough, jagged surfaces and projections.

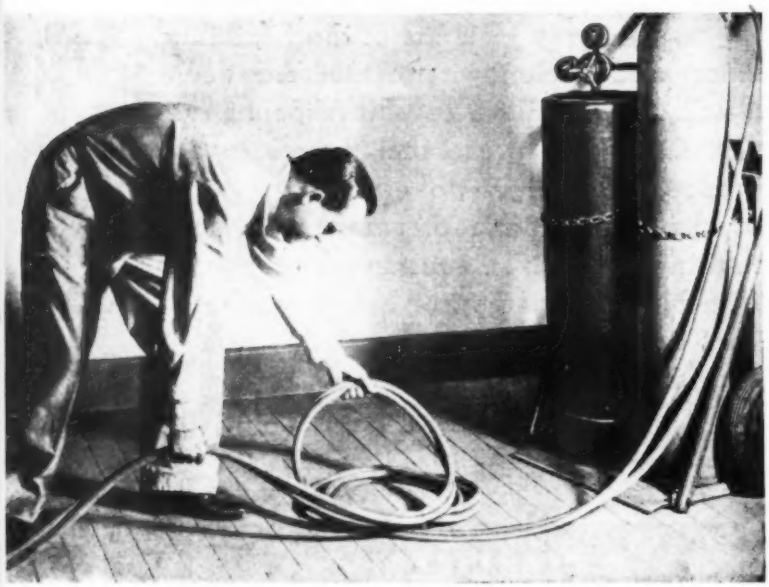
Care exercised when the hose is in use prolongs its life considerably. Protect it against flying sparks, hot objects, open flames. Do not drag it through oil or grease because they rot the rubber. If kinks are not straightened out carefully the hose will break or be weakened so that it leaks. Avoid such damage by making the coils as described below; thus when maneuvering at the work the hose will uncoil without kinking or twisting. *Courtesy of The Linde Air Products Co*



1 When coiling the hose, lay the first loop in the usual manner. Then grasp the next coil length in the right hand with the knuckles pointing downward, as in the photo.



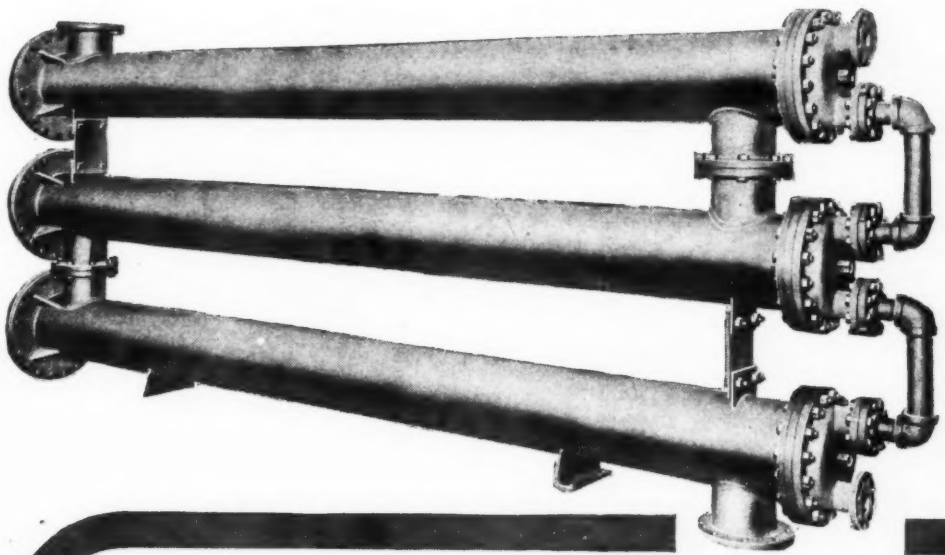
2 To form the second loop of hose, rotate the right hand 90 degrees to bring the knuckles up toward the body, as shown, meantime sliding the hose underneath itself.



3 Lay the third loop in the usual way and position the right hand in preparation for making the next loop, which is a repetition of the method in the first operation.

4 Fourth loop goes under like second; fifth, over; repeat to end. When uncoiled reverse twists of adjoining loops counteract each other; the hose straightens without kinks.

Admiralty Tubes and Muntz Metal Tube Sheets
used in Heaters of Unique Design

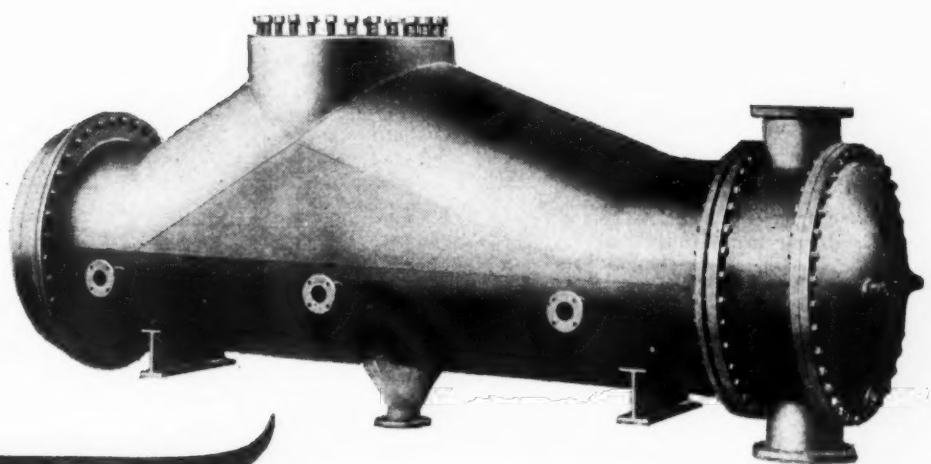


Heat reclaimed from Continuous Blowdown

Heat exchanger built by Alberger Heater Company, Buffalo, N.Y., specially designed for use in a large power plant. Anaconda Admiralty Condenser Tubes and Muntz Metal Tube Sheets assure efficient heat transfer and long life.

Cooling Water used for Process Work

Alberger 2,600 sq. ft. surface condenser for a triple-effect evaporator. With outlet temperature of cooling water thermostatically controlled at 110° F. a saving of 45,000,000 B.t.u. per hour is effected by using the cooling water for process work. Further savings are effected by returning condensate to boiler.



THESE two pieces of equipment were built by the Alberger Heater Company, Buffalo, N.Y., division of the Howard Iron Works. Both were specially designed and constructed for efficient heat transfer, and economical long life. They were equipped accordingly with Anaconda Admiralty Condenser Tubes and Muntz Metal Tube Sheets.

Condenser tube and tube sheet alloys are produced by the American Brass Company in a wide range for heat transfer requirements. The broad experience and metallurgical knowledge of our Technical Department are available to manufacturers and users of condensers and heat exchangers.

For detailed information on Anaconda Condenser Tube Alloys, compositions and fields of application, write for Publication B-2. 45131

ANACONDA

Anaconda Heat Exchanger Tubes

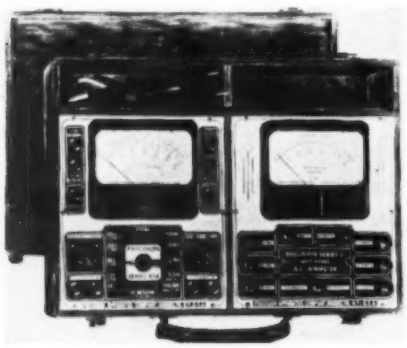
THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

WHAT'S New IN PLANT EQUIPMENT

Circuit Tester

SERIES 856-J super-sensitive multirange ac-dc industrial circuit tester is a unit combination of Precision Series 856 and Series J. This portable combination provides a wide selection of 52 ac-dc voltage and current ranges. The ac-current unit incorporates an internal heavy-duty current transformer for operation on 25 cycles and higher. Two 4½-in. full-vision meters are provided. The 856 meter has 50-microampere full-scale sensitivity, and provides calibration at both 20,000 and 1000



ohms per volt at flip of a switch. Series 856-J affords added advantage of making possible simultaneous measurements of ac and voltage with independent readings on separate meter dials.

Specifications are as follows: (1) seven dc-voltage ranges at 20,000 ohms per v, up to 6000 v (2) seven dc-voltage ranges at 1000 ohms per v, up to 6000 v (3) seven ac-voltage ranges at 1000 ohms per v, up to 6000 v (4) seven dc ranges, 0 to 60 microamperes to 12 amp (5) three resistance ranges, 6000 ohms, 600,000 ohms and 60 megohms, self-contained.

Equipment comes in a portable, hardwood carrying case, with tool compartment and hinged, removable cover. It is supplied complete with ohmmeter batteries and extra-high voltage super-flex test leads. **Dept P, Precision Apparatus Co. 92-27 Horace Harding Blvd, Elmhurst, N. Y.**

Surface Preparation

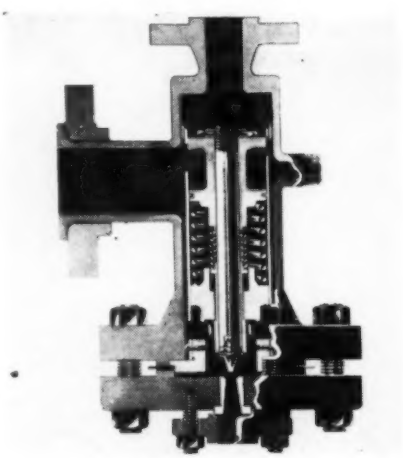
BULL DOG HOLD TITE, a clear liquid, prepares paint, enamel and varnish glossy surfaces for covering coats and for removing wax and grease. Addition of ¼ pt of *Hold Tite* to 1 gal of paint causes new paint to bind or anchor more tenaciously to old finishes. Wiping old surface off with a cloth dampened with this surface preparation quickly cleans and deadens surface gloss. Treated surfaces have a slight tackiness, which is similar to roughened surface produced by sandpapering. **Dept P, Gillespie Varnish Co, Dey and Howell St, Jersey City 6, N. J.**

Recirculating Valve

HAMMEL-DAHL automatic recirculating valve eliminates centrifugal pump failures resulting from insufficient fluid flow through the pump. The system consists of an automatic recirculating valve operated from the fluid flow and designed to bypass minimum quantity of fluid required to eliminate pump overheating. As quantity of fluid passing through pump increases, bypass quantity is automatically throttled and is reduced to zero when output of pump is sufficient to prevent pump failure.

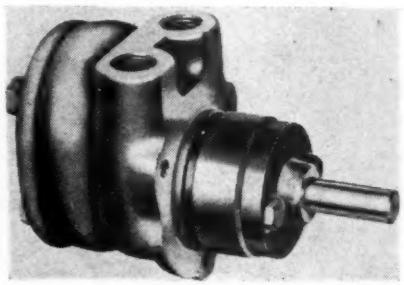
Install valve in existing pump piping by removing any convenient elbow in discharge piping upstream of all checks and stops. With little or no flow through pump, bypass is wide open, recirculating enough fluid to prevent overheating.

If discharge rate starts to increase, plug in valve approaches its seat, decreasing quantity of fluid recirculated. When flow through discharge line is of sufficient magnitude to prevent overheating of pump, bypass valve closes tight, allowing all of pump output to pass through discharge line. On decreasing flows, the above cycle is reversed. **Dept. P, Hammel-Dahl Co. 243 Richmond St, Providence 3, R. I.**



Fiber-Glass Diaphragm

ASKANIA RESEARCH ENGINEERS developed a highly sensitive diaphragm of fiber glass for control and instrumentation. Formerly, only goat's skin was used in diaphragms. Fiber-glass diaphragms are said to be nonporous, nonsagging and nonstretching, are impervious to gases and vapors, have high resistance to alkalis and acids, and have long life. **Dept P, Askania Regulator Co, 1603 S Michigan Ave, Chicago 16, Illinois.**



Rotary Pumps

WITH PROVISIONS FOR HUB, flange and foot mountings, Roper Series K pumps are easy to install. They are adapted to diesel fuel-oil transfer work, pressure-lubricating jobs, hydraulic service, fuel-supply duty, industrial and large domestic oil burners, etc. Pumps, in ¾-, 1½- and 3-gpm sizes, can be direct-connected, chain-, belt- or gear-driven. Self-lubricated by liquid pump, they have only two moving parts. They are self-priming and operate with equal efficiency in either direction. Engineered for clean liquids, pumps handle total suction lifts up to 25 ft, and pressures up to 150 psi. Operating speed is 1740 rpm. Built-in relief valve and mechanical seal are of new design. **Dept P, Geo D Roper Corp, Rockford, Ill.**

Steam-Cleaning Material

OAKITE COMPOSITION No. 92, a heavy-duty alkaline detergent, cleans machinery and equipment parts for subsequent repair and overhaul, prepares equipment surfaces for repainting or refinishing, cleans equipment too large for tank immersion or where suitable tanks are not available, strips paint, etc. This gray-white powdered material dissolves readily in hot water, giving a clear, yellow solution. Composition No. 92 does not clog coils of steam-generating equipment because of its ability to prevent lime- and magnesium-scale formations.

Composition No. 92 may be applied through an Oakite solution-lifting steam model No. 384. Steam source may be a stationary steam boiler, an Oakite vapor-cleaning unit or other self-contained steam-generating equipment. A steel drum of adequate size serves as a solution-delivery tank. Solu-

POWER brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P

Whatever the job calls for

. . . it's in the Crane line

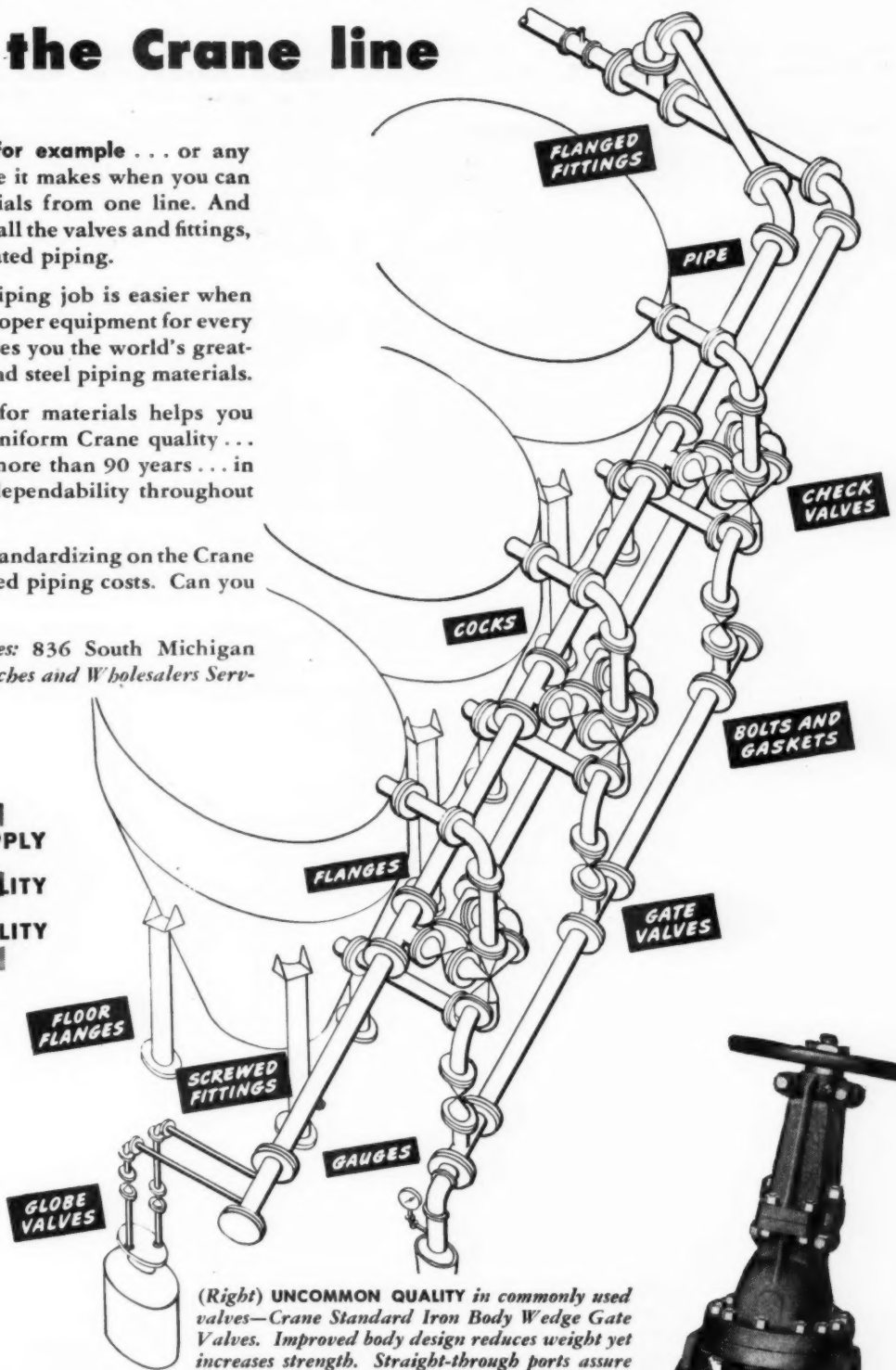
Take this filter installation for example . . . or any piping job. What a difference it makes when you can specify all the piping materials from one line. And when just one order gets you all the valves and fittings, pipe, accessories, and fabricated piping.

From start to finish, any piping job is easier when Crane is your partner. The proper equipment for every service is assured. Crane gives you the world's greatest selection of brass, iron, and steel piping materials.

Undivided responsibility for materials helps you get the best installations. Uniform Crane quality . . . the standard of quality for more than 90 years . . . in every part means uniform dependability throughout piping systems.

This 3-way advantage of standardizing on the Crane line is the sure way to reduced piping costs. Can you afford to overlook it?

CRANE CO., *General Offices:* 836 South Michigan Avenue, Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas.*



ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

(Right) **UNCOMMON QUALITY** *in commonly used valves—Crane Standard Iron Body Wedge Gate Valves. Improved body design reduces weight yet increases strength. Straight-through ports assure streamlined flow. Every detail developed to give dependable, durable service. For steam pressures up to 125 pounds; 200 pounds cold. Patterns for every need. See Crane Catalog, page 101.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

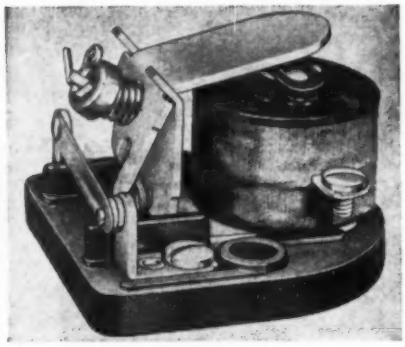
CRANE

FOR EVERY PIPING SYSTEM

tion lifts directly to gun head. It may also be applied with an Oakite vapor cleaning unit or other self-contained steam-generating equipment where a solution of Composition No. 92 is made up in solution tank of steam generator and is passed through coils of unit. **Dept P, Oakite Products, Inc, 23 Thames St, New York 6, N. Y.**

Packed Compression Flange

PENFLEX PACKED COMPRESSION FLANGE consists of a flange ring with an inset section that fits over corrugations on outside of flexible pipe. For flexible exhaust and air-intake pipes, fitting is packed so that when it is drawn up tight on hose it gives a strong, leakproof joint. **Dept P, Pennsylvania Flexible Metallic Tubing Co, 72nd & Powers Lane, Philadelphia, Pa.**



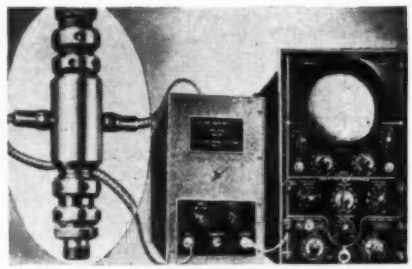
Motor-Starting Relay

MS2A VOLTAGE-ACTUATED RELAY operates on back emf of starting winding. When motor attains speed, this relay immediately disconnects starting coil from line. No overload, with its attendant heavy-current flow, can prevent it from positive operation once proper motor speed has been reached.

Because no centrifugal switch is required, the MS2A is especially applicable to motors that are inaccessible, such as those which are "sealed in," as on refrigerator systems. It also operates especially well on motors subjected to heavy accumulations of dust, dirt and grease. MS2A may be mounted on motor housing or located at any distance, thus permitting motor operation in a combustible atmosphere. **Dept 221, Potter & Brumfield Sales Co, 549 W. Washington Blvd, Chicago 6, Ill.**

Snap Switch

PRECISION SNAP SWITCH is a selfcontained mechanism for making or breaking a circuit, in small space, with short movement and light pressure. Although small in size, about 2½x1x⅞ in., this new Class 9007, Type A snap switch features husky construction, unusual mounting convenience and 550-v rating. **Dept P, Square D Co, 4041 N Richards St, Milwaukee 12, Wis.**



Pressure Indicator

LATEST MODEL PRESSUREGRAPH provides, with a cathode-ray oscillograph, a substantially linear pressure-time curve on the screen, which indicates performance of any engine, pump or other device subject to pressure variations. It is for studies of all internal-combustion engines, pumps, compressors, air and liquid pipelines, etc. It shows instantly erratic operation of a device that normally cannot be observed by other means because of inertia of flywheels and other factors.

In addition to dynamic-pressure variations, it shows static- or slow-pressure variations. It covers all mechanical speeds and pressures up to 10,000 psi. The new *Pressuregraph* provides for temperature compensation. There are three output selections: (1) for double-modulated wave (2) for indicator-card wave (3) integrated single line for transmission of pickup response to a string oscillograph for photograph recording.

The redesigned pickup has been made vibrationproof, and is furnished with or without water cooling. New cabinet construction provides special convenience with better arrangement of connections. It is for mounting alongside the oscillograph in similar cabinet, making a compact and attractive assembly as a complete testing and recording unit. **Dept P, Electro Products Laboratories, 349 W Randolph St, Chicago 6, Ill.**

Differential Transmitters

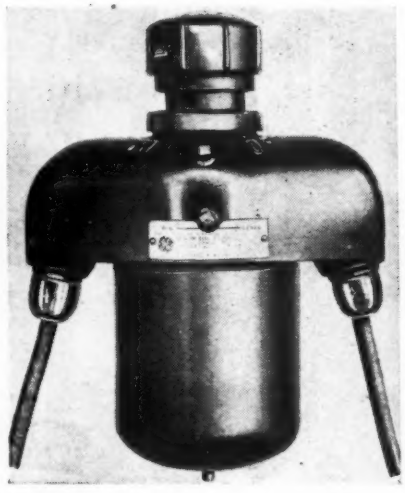
PNEUMATIC TRANSMITTER measures flow of hot liquids, which are so viscous at room temperature that they congeal in lead lines. A piston is used instead of an ordinary diaphragm to avoid effect of hot liquids on diaphragms. Transmitter is designed for installation in a manner that keeps measuring chambers hot enough to prevent measured fluid from congealing in transmitter chambers and lead lines. Piston and cylinder are made of steel of the same composition so clearance is maintained regardless of temperature changes. **Dept P, Republic Flow Meters Co, 2240 Diversey Parkway, Chicago 47, Ill.**

Check Valve

NUMATIC SAFETY CHECK eliminates danger of wildly whipping compressed-air hoses by shutting off air immediately in event of excessive flow of air caused by accidental disconnection or rupture in air line. Possibility of damage to compressors or manifolds through travel-back of whipping action in hoses is also obviated. There are only two main parts—housing and a steel ball. Valve housing proper has female threads in both ends for attachment to compressor and air line. For convenience of installation the ends are hexagonal in shape. *Numatic* safety check is manufactured for working pressures up to 250 psi and comes in standard half-inch and three-quarter-inch sizes. Manufactured by **Hackett Mfg Co, Oakland, Calif.** Distributed by **Dept P, E D Bullard Co, 275 8th St, San Francisco, Calif.**

Insulating Varnish

KNOWN AS HARVEL 912C, new internal-curing insulating varnish involves no change in curing equipment. Typical operational curing schedule of this phenol-aldehyde varnish in standard convection ovens, based on actual coil curing, is 2 to 4 hr at 285 F, 3 to 5 hr at 260 F and 4 to 6 hr at 250 F. These periods may be reduced with infrared equipment. **Dept P, Irvington Varnish & Insulator Co, Irvington, N. J.**



Oil-Fuse Cutouts

IMPROVED LINE of heavy-duty oil-fuse cutouts provides overcurrent protection of power distribution systems in 2400-, 4160-, 4800- and 7200-v classes. Cutouts utilize the new universal fuse links for higher interrupting ratings, clearing fault currents as high as 11,000 amp, depending upon the rating. With this new design, 100-, 200- and 300-amp rating cutouts, with maximum short circuit interrupting ratings previously limited to 2500 v, are now extended to 5000 v. Cut-

POWER brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P

Because power plants need CONDENSER TUBE PLATES

Revere Condenser Tubes are preferred because of their long, satisfactory service, and so are Revere Plates, for the same reason. The two make a perfect combination, both being made with the same high skill, to the same standards.

Our long experience makes it possible to deliver to you plates that are dense, free from blow holes and surface imperfections, characterized by flatness, accuracy of gauge, machinability and resistance to corrosion.

Revere Condenser Tube Plates are available in squares, rectangles, circles, half-circles, segments, patterns, up to 120 inches. Finished weight, up to approximately 11,000 pounds. Metals include Admiralty Metal, Muntz Metal, Naval Brass and Cupro-Nickel. Revere Condenser Tubes are available in these, and also in Revalon (aluminum brass). Other Revere products for power plants include copper tube and pipe, Red-brass pipe, copper bus bar, Herculoy (silicon-copper alloy) in plate, sheet, strip, rod, forgings. For advice in the selection of the proper non-ferrous alloys for your purposes, write Revere.

Pouring a 12,000-pound cake of Revere Cupro-Nickel for a Navy Condenser Tube Plate.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

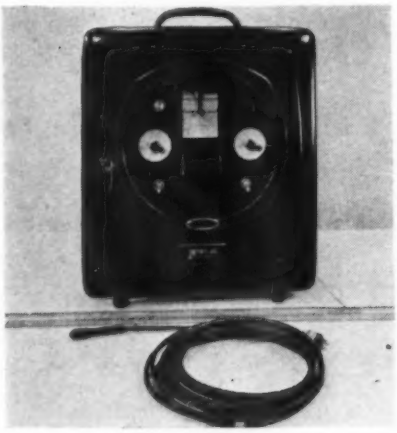
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.

Sales Offices in Principal Cities, Distributors Everywhere.

• • •

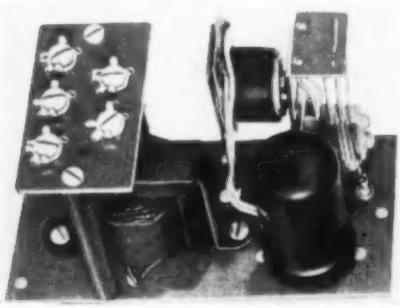
Listen to *Exploring the Unknown* on the Mutual Network every Sunday evening, 9 to 9:30 p. m., EDST.

outs provide a high degree of safety for there are no exposed live parts and no arc flames are ejected during current interruption. **Dept P, Transformer Div, General Electric Co, Schenectady 5, N. Y.**



Defective-Tube Detector

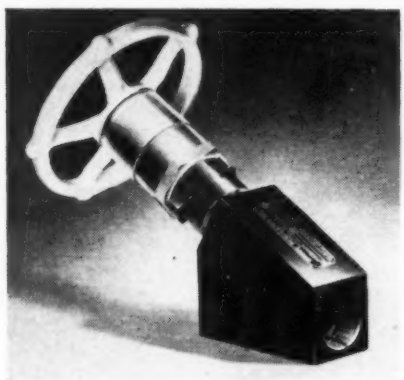
ELECTRONIC PROBOLOG, equipped with a flexible cable terminating in a magnetic probe, locates eroded spots, corroded pits, dezincification areas, cracks and abnormal changes in physical dimension of nonmagnetic tubes in steam condensers and heat exchangers. Inspection is thorough, and defective tubes are quickly located before they fail. Instrument takes the guesswork out of tube replacement —no good ones are removed by mistake and no bad ones are left in place. **Dept P, Shell Development Co, 50 W 50th St, New York 20, N. Y.**



Sensitive Relay

NEW ELECTRONIC RELAY utilizes hot-cathode thyratron principle. Operation is from 110-v, 60-cycle, ac lines. Switching action is SPDT, or up to 4 PDT for loads to 12 amp. Up to 100 ft of either conduit, *BX* or coaxal cable may serve for connections between external actuating source and electronic relay. While design is suitable for mounting inclosed, general-purpose as well as dust-tight inclosures are available.

Applications for the device are: (1) in photocell circuits for direct-control actuation of motors, valves, alarms, etc (2) motion and limit control within micro-inches on textile machinery, wire stranding machines, etc (3) conversion of delicate, contact-making instruments, such as mercury-column thermometers, meter relays, recorders, precision gages and electrical flowmeters, into positive-control devices without causing arcing or welding of electrodes (4) liquid-level control where electrodes may be immersed in a tank and govern low-level and high-level limits. **Dept P, Automatic Temperature Control Co, 34 E Logan St, Philadelphia 44, Pa.**



Globe Valves

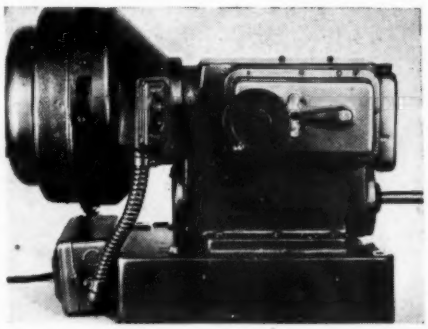
SERIES V AND VL represent an advancement in valve design. Extreme 30-deg valve-body design in globe pattern effects a minimum change in flow direction through valve. Also, turbulence is almost entirely eliminated, according to maker, as flow stream is carried through valve in direction of closing. Expansion takes place directly into downstream line after flow has passed through valve. Thus wire drawing and cutting action is almost entirely removed.

Solid one-piece stem and plug is employed to effect absolute tight shutoff when closed. Valve stem is not directly carried by handwheel, which removes any chance of stem becoming distorted or bent. Multiple full-threaded section of handwheel and yoke absorbs shocks. Incasing cap shield protects all threaded surfaces and operating parts from paint, dirt and damage. Special factory-sealed process provides constant "lifetime" lubrication to essential operating parts of valve. Sealed lubricant is "zoned" entirely away from flow stream and isolated from temperature effects.

This new design in 30-deg globe and 90-deg angle pattern is provided in *Fullstream* quick-opening shutoff valves, *Microstream* throttling valves, *Coldstream* shutoff valves, internal and external check valves, and strainers. **Dept P, Grove Regulator Co, 65th & Hollis Sts, Oakland, Calif.**

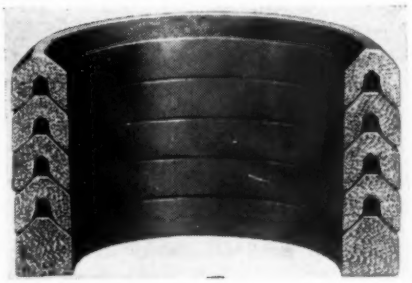
Variable-Speed Transmission

MODEL HT2 TRANSMISSION, equipped with an axial air-gap built-in electric-drive motor, is available in 2-, 3- and 5-hp size ratings. Infinitely variable speeds, throughout entire



speed range from zero to neutral, to full drive motor speed (both forward and reverse) are said to be instantly available. In addition, hydraulic variable-speed transmission provides starting torque at all times for heavy-load starting. This transmission lends itself to those installations where a compact variable-speed drive is desirable. Various controls other than the handwheel shown may be furnished.

Over-all dimensions are as follows: height to top of motor, 17¼ in.; width, 12 in.; length, 26 in. It can be furnished with motors providing maximum speeds of either 1140 or 1725 rpm. **Dept P, Portman Machine Tool Co, 70 Portman Rd, New Rochelle, N. Y.**



Packing Rings

PALMETTO PYRAMID PACKING, in molded-ring form, has heavy wearing surfaces. For assembly inside of stuffing box, the bottom ring is installed first and receives full impact of pressure on power stroke. This bottom ring expands wedge-shaped lip of each ring above it so the packing is pressed against both rod and side walls, preventing leakage. Infiltration of fluid between rings and storage of fluid in arrowhead reservoir prevents binding. Ease of operation is assured by curved design of interior-lip surface, which also prevents friction within packing.

On return stroke lessening of pressure per-

(*Continued on page* 150)

POWER brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P

This is the Place to Lick *boiler foaming*

...says *Tom Cocks*

Nalco Representative, St. Louis, Missouri

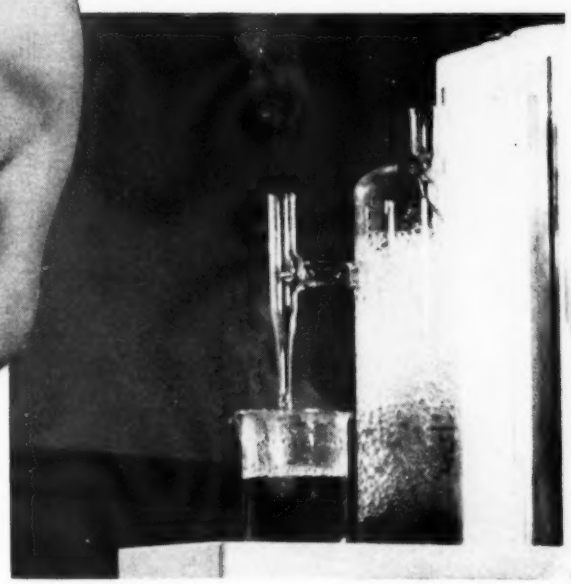


Photo in Nalco Laboratories

BOILER carryover resulting from foaming can cause damage ranging from corrosion and scaling in steam lines and equipment to outright wreckage of engines and turbines . . . And the place to lick it is *not* in your own boilers—but in the Nalco Laboratory devoted to anti-foam research and remedies for foaming.

Like any other phase of good water treatment, there is no single cure-all for foaming. Nalco Laboratory testing under your particular plant operating and water conditions guarantees treating chemicals and control recommendations that solve *your* problems. No obligation is involved in a complete Nalco Survey for your plant. . . . Ask for it today.

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THE SCIENTIFIC WATER TREATMENT FOR ALL INDUSTRY

How to plan

LOW PRESSURE BOILER AND UNIT HEATER CONNECTIONS

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

The low pressure heating system shown here is typical of those commonly installed in warehouses, manufacturing lofts, office buildings, and single story structures where there is no need for high pressure steam. Also shown in detail is the conventional domestic hot water hookup and the unit or projection heaters usually installed with this type of system.

The efficient layout for maintenance permits repair of either the unit heaters or the hot water supply system without a complete shutdown. The by-pass around the automatic water feeder permits hand filling of the boiler in the event of feeder failure. A main shut-off valve "L" is provided on the boiler so that no heat will be lost in the heating mains when the system is operated only for hot water.

Trouble is avoided by the use of a unit heater aquastat which prevents the fan from turning on with no steam in the lines. Back flow to the trap and strainer is prevented by a check valve.

All valves except the main shut-off are bronze to assure the best service under the usual steam and water conditions. The bronze gate valves recommended are of the traveling spindle type which serves as an indicator to show if the valve is open or closed. The Fig. 106A Bronze Globe Valves are recommended because of such outstanding features as the reinforcing bevel joint between body and bonnet, the convenient, slip on, stay-on disc holder fitted with a genuine Jenkins Renewable Composition Disc, and the perfect-grip, non-heat, non-slip handwheel.

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A Use the right type valve for the service.
B Place valves correctly in the line.
C Choose Jenkins Valves for lifetime economy.

12

Fig. 651, Iron Body Bronze Mounted Gate Valve
125 lbs. Steam
200 lbs. O.W.G.

Other types and pressure ranges of Jenkins Valves can be used for this type of layout according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installation.

Copies of Layout No. 12 will be furnished on request . . . also copies of future Piping Layouts. Just fill out and mail coupon.

Fig. 651, the Jenkins Iron Body, Bronze Mounted Gate Valve recommended in this layout is especially suitable for steam lines. The solid wedge provides maximum resistance to pressure strains, assuring long life even in rapidly vibrating steam currents. Operating threads on the bronze spindle are readily accessible for cleaning and lubrication. The bronze seat ring is renewable.

A CHOICE OF OVER 600 JENKINS VALVES

To save time, to simplify planning, to get the advantage of Jenkins specialized valve engineering experience, – select all the valves you need from the Jenkins line described in the Jenkins Catalog. It's your best assurance of the *lowest cost in the long run.*

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JENKINS VALVES

LOOK FOR THE DIAMOND MARK
SINCE 1864

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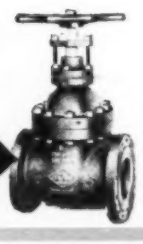
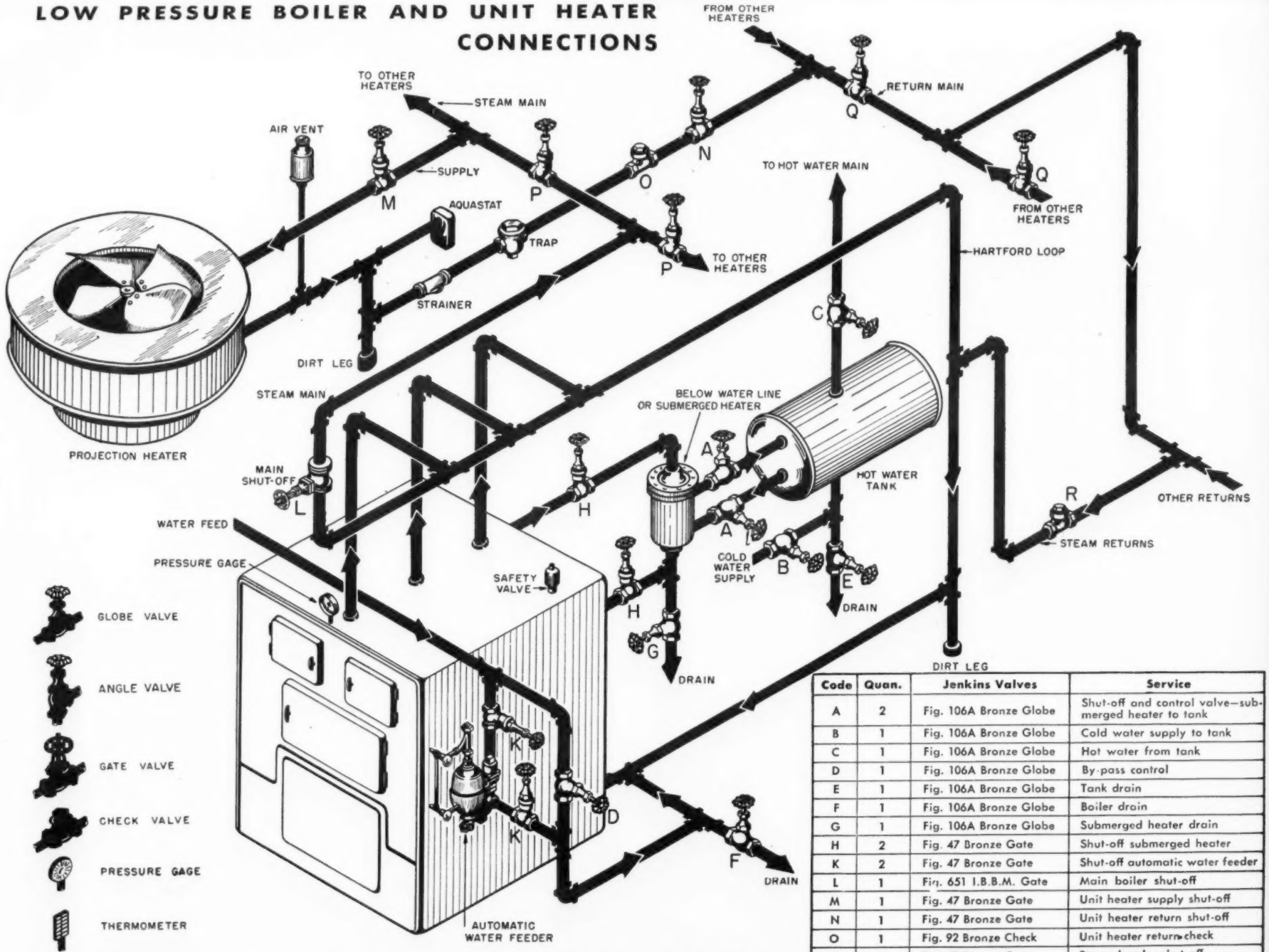


125 TO 600 LBS. PRESSURE

Jenkins Bros

LOW PRESSURE BOILER AND UNIT HEATER CONNECTIONS



Diagrams by Huxley Madeheim, Consulting Engineer

VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog

Code	Quan.	Jenkins Valves	Service
A	2	Fig. 106A Bronze Globe	Shut-off and control valve—submerged heater to tank
B	1	Fig. 106A Bronze Globe	Cold water supply to tank
C	1	Fig. 106A Bronze Globe	Hot water from tank
D	1	Fig. 106A Bronze Globe	By-pass control
E	1	Fig. 106A Bronze Globe	Tank drain
F	1	Fig. 106A Bronze Globe	Boiler drain
G	1	Fig. 106A Bronze Globe	Submerged heater drain
H	2	Fig. 47 Bronze Gate	Shut-off submerged heater
K	2	Fig. 47 Bronze Gate	Shut-off automatic water feeder
L	1	Fig. 651 I.B.B.M. Gate	Main boiler shut-off
M	1	Fig. 47 Bronze Gate	Unit heater supply shut-off
N	1	Fig. 47 Bronze Gate	Unit heater return shut-off
O	1	Fig. 92 Bronze Check	Unit heater return check
P	2	Fig. 47 Bronze Gate	Steam header shut-off
Q	2	Fig. 47 Bronze Gate	Return header shut-off
R	1	Fig. 92 Bronze Check	Return check

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POWER'S DATA SHEETS

Number 167

Supersaturated Steam Flow

▶ THESE CURVES apply to steam flow through well-rounded orifices, flow nozzles and turbine and ejector nozzles. They are based on the supersaturation theory advanced by Aitkens, Wilson and Stodola (POWER, Oct 4, 1927, p 511).

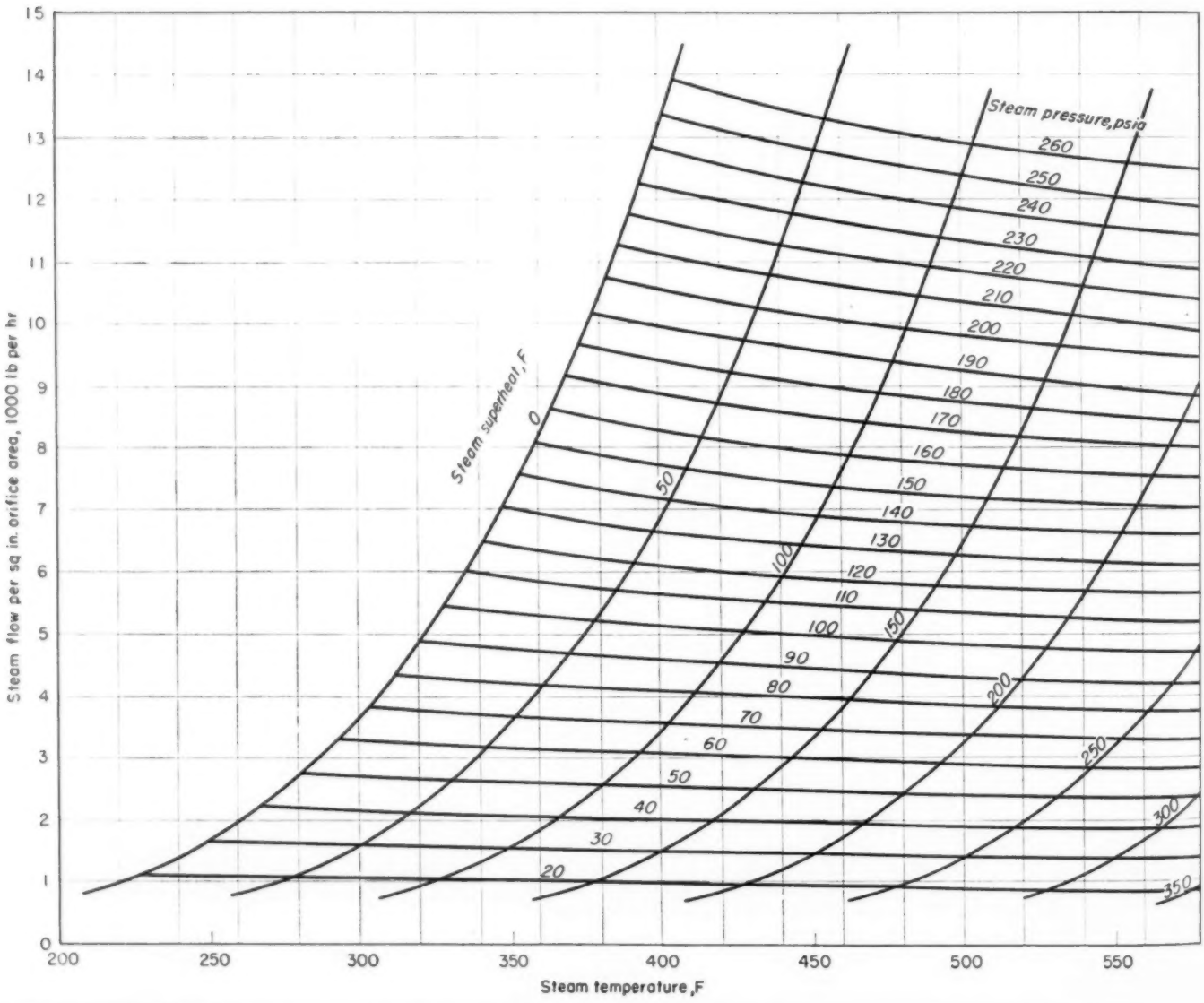
Flow calculations based on equilibrium conditions for steam expanding from a dry to a wet state yield flow rates 3 to 5% less than actual. Equilibrium conditions assume that as steam expands into a wet saturated state it condenses in conformance with usual saturation temperature and pressure relations.

However, because of expansion rapidity, steam momentarily cools below temperature corresponding to saturation pressure with less than normal moisture forming. While this unstable condition prevails for only a very short time during flow, it exists long enough to increase flow rate above equilibrium expectations. This chart takes this phenomenon into account and applies to conditions where exhaust pressure equals or is less than about 55% of initial steam pressure.

Example: How much 100-psia 440-F steam will a 2-sq-in. cross-sectional area nozzle pass when exhausting to a pressure of 55 psia or less?

Find 440-F ordinate on the chart, then follow up to intersect with the 100-psia curve and follow left to read 5000-lb-per-sq-in. orifice area. Total flow = 5000x2 = 10,000 lb per hr.

By Philip Freneau, Elliott Co



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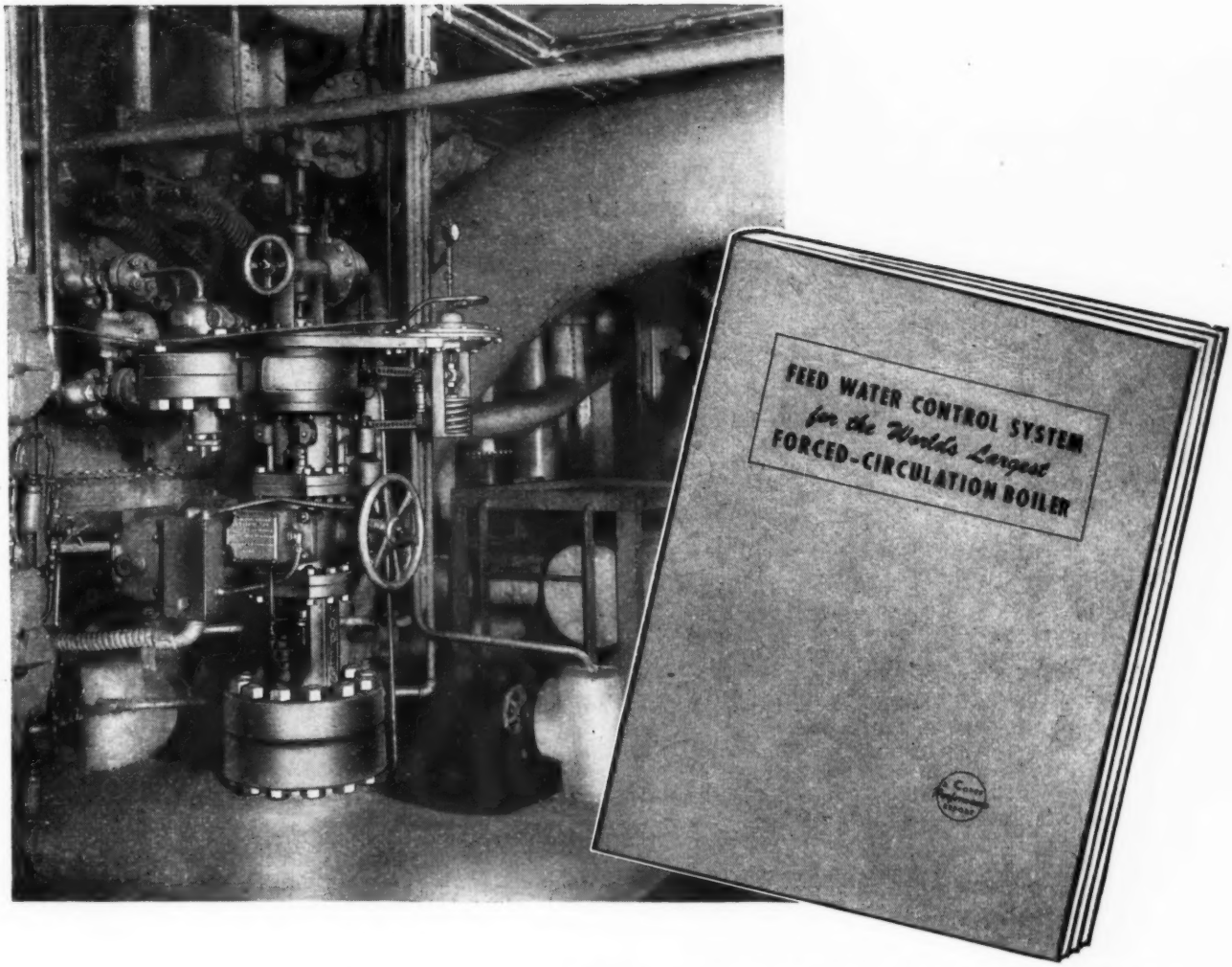

A COPES *Performance* REPORT

FEED WATER CONTROL SYSTEM *for the World's Largest* FORCED-CIRCULATION BOILER

Here is the story of the feed water control developed by COPES for the world's largest forced-circulation boiler at Somerset Station, Montaup Electric Company. Charts show the close stabilization of water level under base-, regulating- and emergency-load conditions. Write for Bulletin 447.

NORTHERN EQUIPMENT COMPANY

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FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

Nothing New—Much . . .

We hired a new assistant chief a couple of months ago. He's a bright lad, full of ideas about his job, impatient with delays. The other day he burst out: "It seems to me that every time I think I've got a new idea, I find out that you tried the same one 20 years ago. What's the matter—am I just behind the parade?"

"No, Son," I said, "You're just finding out that there's very little new under the sun. But don't give up—some of those ideas that wouldn't work 20 years ago will work now, and we need somebody with the gumption to try 'em again. They may turn out to be old ideas, sure, but you can give 'em a new twist that salvages 'em."

Then I told him about super-battleships, bombs, mass production and rockets.

Our history books tell us that the *Monitor* and the *Merrimac* changed the history of naval warfare—they were the first ironclad ships. Not so. The Koreans beat off the Jap Navy in 1595 with "tortoise boats" topped and sheathed with iron and copper plates. They even had cannon at side ports, and a bronze dragon with spiked tail for ramming. What's more, the dragon head breathed fire-flaming arrows.

Then there's our explosive shell. The Koreans had that too at the same time. They fired a big shell (called "The Flying Thunderbolt") into the courtyard of a Jap-held castle. When the Samurai gathered to look, it blew up and killed about 30 of 'em.

In 1941 we bragged and shouted about our "new" methods of building ships on an assembly line, said it won us the war. The Venetians said the same thing when they were fighting the Turks back in 1275, when they built biremes by assembling prefabricated parts along a lagoon. They, too, built a ship in a day.

What happened to all these ideas? Sooner or later, each was forgotten or discarded as "out of date." Then somebody with vision modernized 'em and put 'em to work.

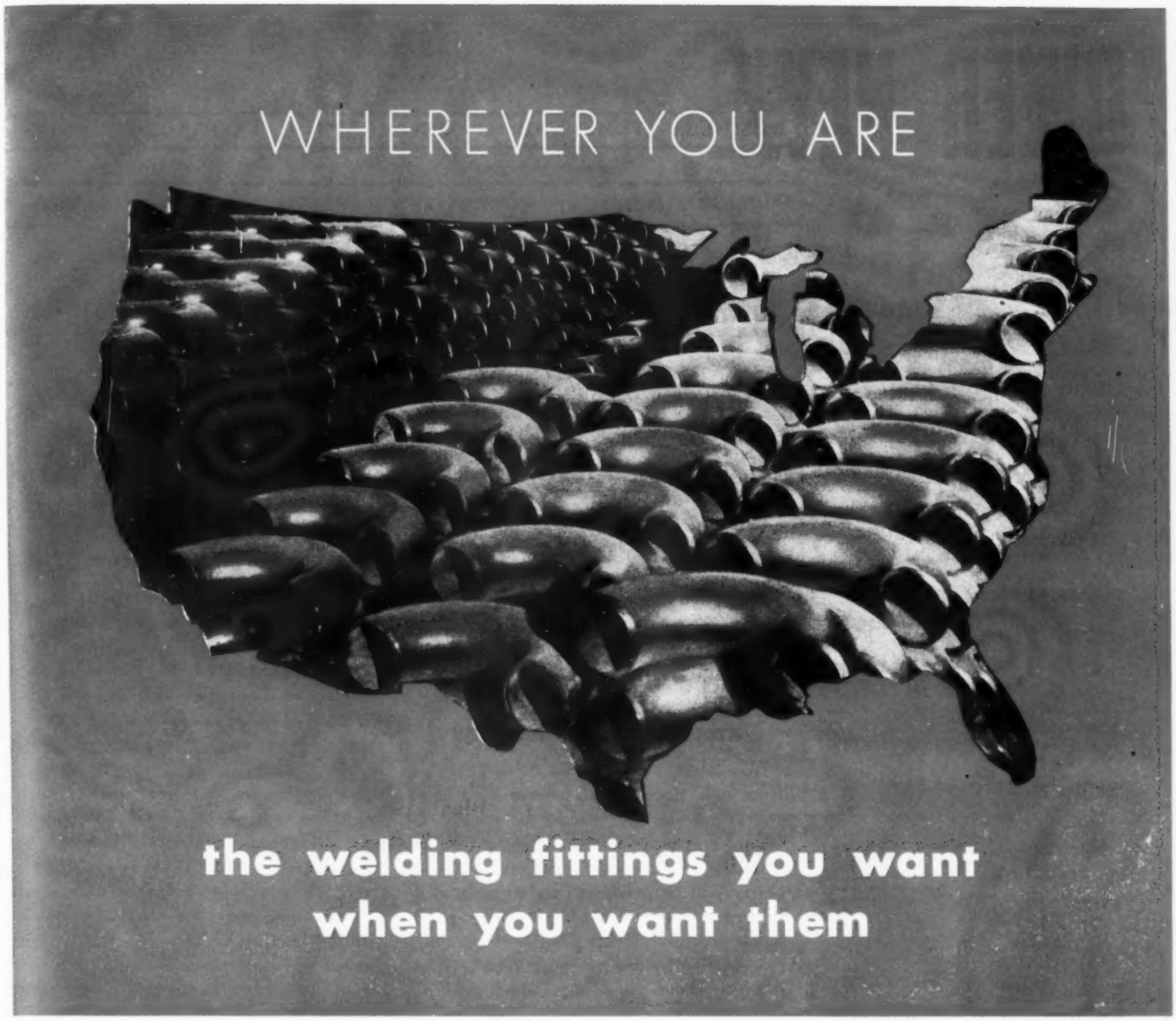
There's another example even more striking. The Chinese fired rockets against the Mongols in 1232. By 1400, European armies were using 'em too. Then along came cannon, and by 1500 rockets were "obsolete." But when the natives in India used them tellingly against the British toward the end of the 18th century, the British stole the idea. "Congreve's" rockets were fired against Boulogne, Copenhagen, Danzig and Leipzig during the Napoleonic Wars. At the Battle of Bladensburg in 1812, American militiamen defending Washington broke before a flanking fire of rockets, and three weeks later Francis Scott Key wrote a song including the words "the rockets' red glare" when he saw them fired against Fort McHenry. By 1846, even the United States had a rocket battery. We used rockets in the Mexican War, a new type that spun. They worked well—but by 1850 rifled gun barrels and new recoil mechanisms set a standard rockets couldn't meet.

Then along came World War II, and the guns, planes and tanks we had developed so carefully were almost overshadowed by the comeback of the rocket in every form from a signal flare through the bazooka to the mighty German V-2 that carried a ton of explosive to a target 200 miles away.

There's nothing new under the sun, I guess, but every so often somebody certainly gives an old idea a brand new twist.

George Edwards

Engineer



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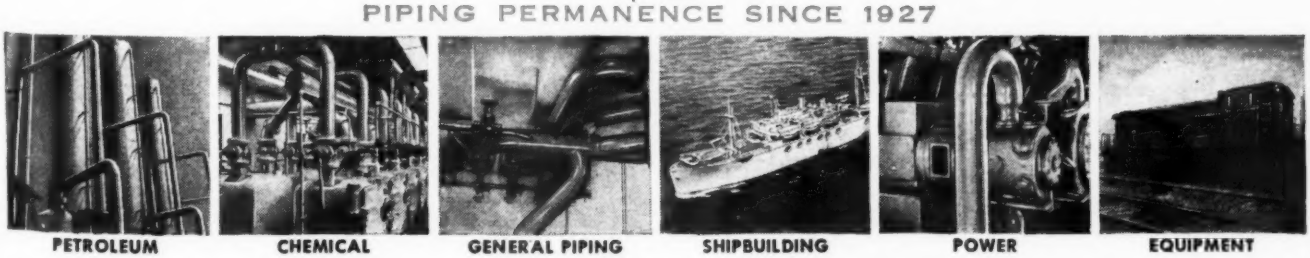
PIPING PERMANENCE SINCE 1927



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POWER NEWS

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Westinghouse Foundation Sponsors Science Forum

▶ THE GEORGE WESTINGHOUSE Centennial Forum, "Science and Life in the World," held in Pittsburgh on May 16-18, was composed of symposia and addresses arranged to provide an opportunity for scientists, engineers and scholars to correlate present knowledge and to consider subjects for future research. It was

MARVIN W SMITH

spon-ored by the Westinghouse Educational Foundation. Marvin W Smith is chairman of this foundation.

At the symposium, "Science and Civilization," on Thursday morning, May 16, scientists were called upon by Dr Archibald V Hill, British Nobel Prize winner, to "supply by our example of honesty, humility and regard for facts" the way to establishment of ethical conduct in all international relations. Dr Isaiah Bowman, president of Johns Hopkins University, declared that world peace plans are futile unless planners face realities posed by the power which science and engineering have extended to "awesome dimensions." Third speaker on the symposium was George W Merck, chairman of the U. S. Biological Warfare Committee. He discussed "Scientific Ethics."

Sounding the theme of the 3-day forum at a noon luncheon, Gwilym A Price, president of Westinghouse Electric Corp and treasurer of Westinghouse Educational Foundation, and L W Chubb, director of company's research laboratories, urged that scientific knowledge be applied "so that more people may benefit by it more quickly."

At the Thursday afternoon symposium, "The Future of Atomic Energy," Dr Enrico Fermi, professor of physics at University of Chicago and Nobel Prize winner in 1938 for his work on bombardment of the atom, claimed that there is definitely a technical possibility that atomic power may gradually develop into one of the principal sources of useful power. Chief obstacle will be ogranizing a large industrial development in an internationally safe way.

ATOMIC-ENERGY PRODUCTION

We might conceive that 20 or 30 years from now the general scheme of atomic energy production would be about as follows: There will be large central installations in which great amounts of power will be produced and transformed into electrical energy or steam for local power consumption. Besides producing power directly, these large units may also produce some plutonium, which will be extracted and distributed to small installations where plutonium and not uranium will be primary fuel. It permits wide use of relatively small power units, reducing distribution difficulties.

Speaking on the same program were Dr Hugh S Taylor, dean of the Graduate School, Princeton University, who played a prominent part in mobilizing science during World War II; Dr J Robert Oppenheimer, professor of physics, University of California, who directed the laboratory at Los Alamos where atomic bomb was perfected; and Dr W Edward Chamberlain, professor of roentgenology and radiology, Temple University.

PLANNING IN SCIENCE

Dr Vannevar Bush, director of Office of Scientific Research and Development, who was head of the U. S. wartime scientific command, asserted at the dinner meeting on Thursday, May 16, that "for the good of the world and for the development of peace and plenty under the aegis of the United Nations," the balance of power among the five great world powers "must be redressed." Dr Bush's subject was "Planning in Science," but this, he said, we cannot speak of as a thing by itself. Science does not exist or operate in a vacuum and for discussion to be useful planning in science must be regarded as "a part of the planning which is basic to proper functioning of the whole complex of industry, commerce, education, social action and government that goes to make up the U. S."

At the symposium, "Transportation—A Measurement of Civilization," on Fri-

(*Continued on page* 174)

COMING EVENTS

Aug 19-23—National Power Show, Public Auditorium, Cleveland, O. National Assn of Power Engineers, A F Thompson, director of exhibits, 176 West Adams St, Chicago 3, Ill.

Sept 10-14—Fourth National Chemical Exposition, Chicago Coliseum, Chicago, Ill. Chicago Section, American Chemical Society, Marcus W Hinson, mgr, 330 S Wells St, Chicago 6, Ill.

Sept 16-20—First National Instrument Conference & Exhibit, Wm Penn Hotel, Pittsburgh, Pa. Instrument Society of America, Richard Rimbach, exec secy, 1117 Wolfendale St, Pittsburgh 12, Pa.

Oct 1-4—Meeting, Public Auditorium, Cleveland, O. Association of Iron & Steel Engineers, John B Harmon, exhibit manager, Empire Bldg, Pittsburgh, Pa.

Oct 26-28—Meeting, Hotel Hollenden, Cleveland, O. Refrigeration Service Engineers Society, H T McDermott, international secy, 433 N Waller Ave, Chicago 14, Ill.

Oct 28-30—Seventh Annual Water Conference, Wm Penn Hotel, Pittsburgh, Pa. Engineers' Society of Western Pennsylvania, K F Treschow, secy, Wm Penn Hotel, Pittsburgh, Pa.

Oct 29-Nov 1—All-Industry Refrigeration Show, Public Auditorium, Cleveland, O. Refrigeration Equipment Manufacturers Assn, R Kennedy Hanson, secy, 1107 Clark Bldg, Pittsburgh, Pa.

Payoff inside a pulverizer!

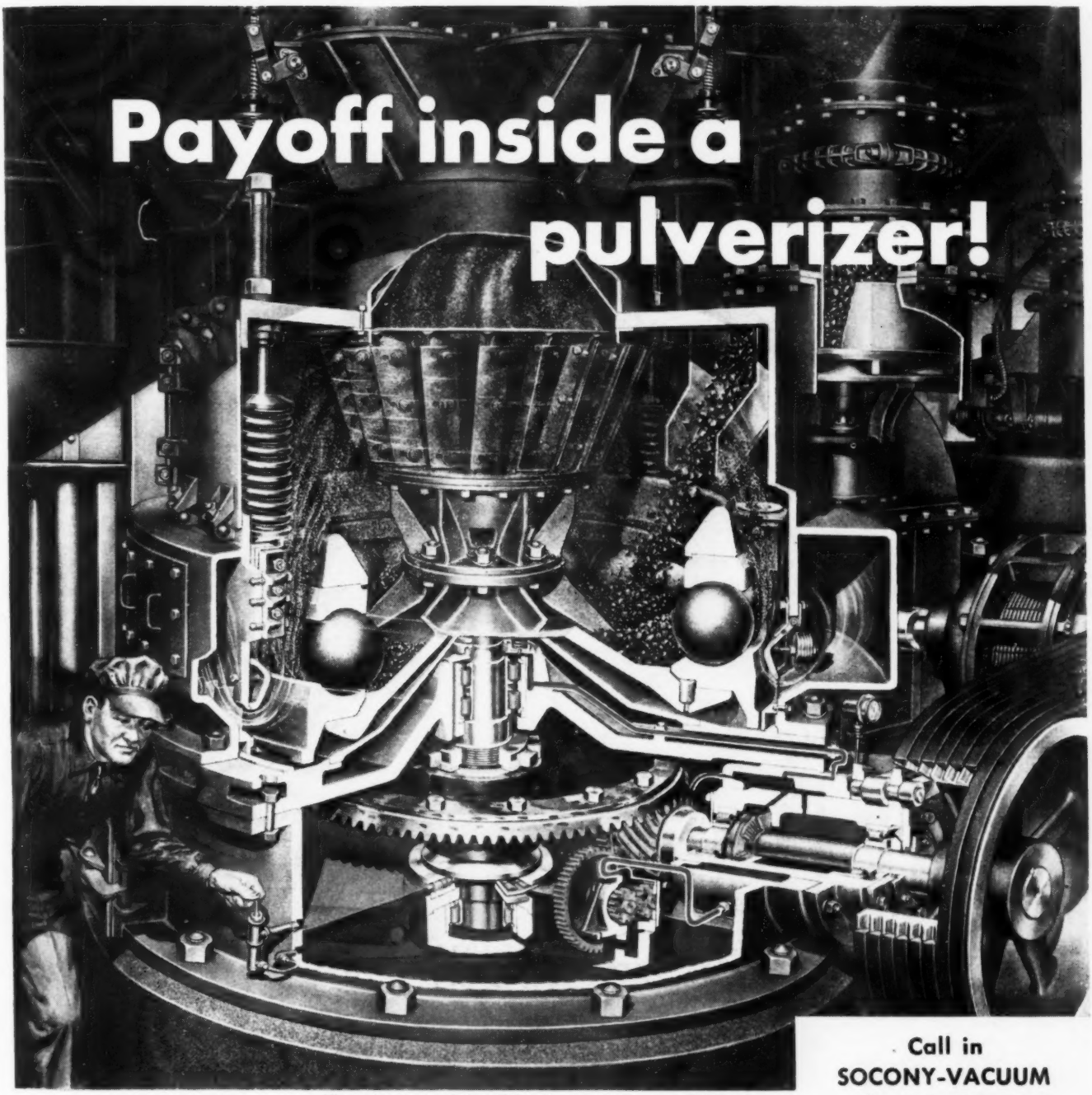

Illustration prepared in collaboration with Babcock & Wilcox Co.

FOLLOW those hefty steel balls shown grinding coal lumps to fine dust inside this big pulverizer. Imagine the loads that lubricating oil has to carry on the bearings and gears.

This is a typical example of how Correct Lubrication by Socony-Vacuum helps maintain efficient, low-cost operation. There are others in almost every machine in every industry.

Here, for example, the weight of the entire operating mechanism rests on thin films of oil under the thrust bearing at the base. Those precision-cut gears and roller bearings operate under continuous high pressures. Yet a special Gargoyle circulating oil cushions the shocks, protects against wear, stands up for long periods of service even though operating temperatures may be high due to induced heat.

The result — more continuous production, reduced maintenance and lower oil costs — the same factors that you get for *all* your machines with Socony-Vacuum's *correct* oils and greases.

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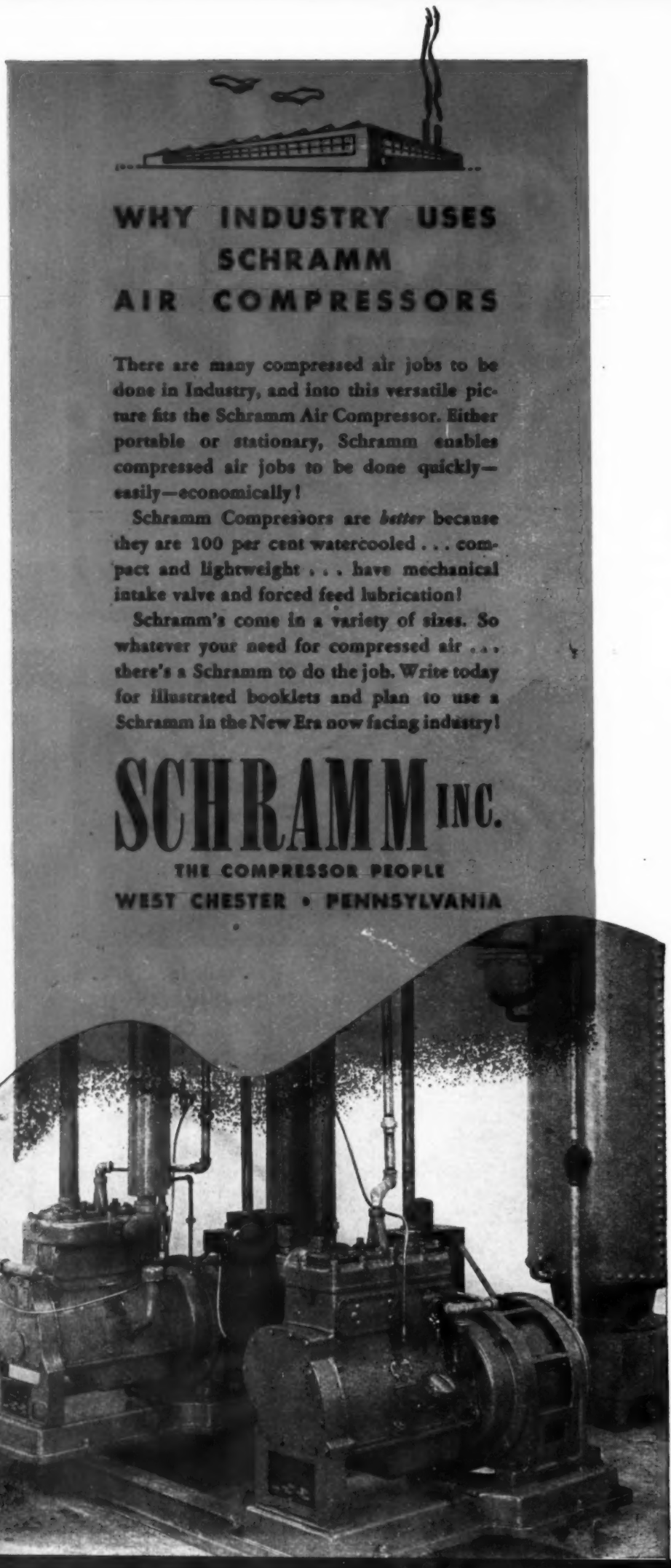
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Reader's Problems

(*Continued from page* 111)

Reduce Flyash in Boiler

CAM SAYS HE has had trouble with his boilers because of tube erosion from some external source, presumably the soot blower. His boilers have had good care and are equipped with chain-grate stokers.

Chain-grate stokers, because of forced draft, tend to produce considerable flyash, which is highly abrasive, particularly if fine coal is used. The amount of ash increases rapidly as the coal becomes finer, assuming the draft remains the same.

I know of several similar cases and in each one the soot blower was the source of the trouble, either directly or indirectly. One recent case occurred in a boiler only six years old in which external erosion was responsible for tube failure because of the sand-blast effect of flyash when high velocity had been imparted to it by a soot blower.

To correct the trouble, carefully check the soot blowers to be sure there is no misalignment or excessive nozzle deformation due to wear. If flyash is building up in the area where erosion has been found I suggest: (1) Use the soot blower more frequently. (2) Reduce forced draft of the point where fewer fines are carried out of the furnace. (3) Lower pressure for the air used in the soot blowers so the velocities imparted to flyash are sufficiently low to prevent erosion.

New Orleans, La. W R KILBOURN

Leaks Cause Errosion of Boiler Tubes

CAM SEEMS to spot the trouble when he says the tube damage was probably caused by the action of the jets from his soot blowers. The air itself would not do the damage but flyash blown against the tubes would cause erosion and eventually, tube failure. If this is the cause of trouble, tube blowing should be done when the boiler is not working, or only lightly loaded.

Another frequent cause of tube failure in watertube boilers is an undetected leak. This often spoils five or six tubes. A small leak, not discovered for some time, will drip water onto other tubes. The water combines with soot to form sulphuric acid, which rapidly eats tubes away.

Beverly, Mass. R D GOLDSMITH

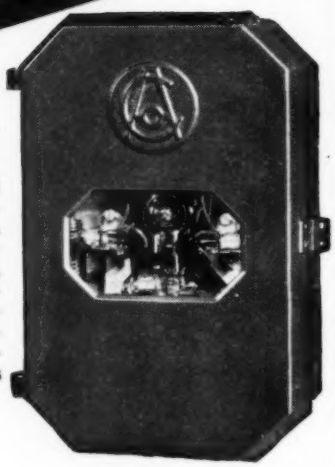
CHAPMAN LIST 600

...with the Precision Rating of a Custom-Made Valve

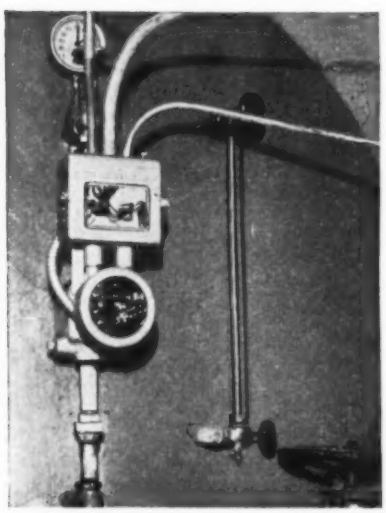
Chapman Steel Valves are made with production-line speed and economy, yet have the precision rating of custom-made valves—*equalling or exceeding* standard specifications. Metals used in Chapman Steel Valves are developed and produced under strict metallurgical control in Chapman's own foundries, thus *insuring* high performance of all valves in even the severest services.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASS.

Accurate
CONTROL of
WATER LEVEL
for Elevated
TANKS
With
AUTOMATIC TANKTROL CONTROL CO.



For controlling remote and nearby elevated tanks by pressure, TANKTROLS are unsurpassed. Handles up to 3 or 4 pumps or alarm circuits. The TANKTROL exclusive two-bellows construction assures accuracy of 1% and full sensitivity over unusually wide operation range. Settings are permanently accurate. Automatic surge and backspin protection. Bulletin T-11 gives complete information—write for it. State requirements and engineering data will be furnished.



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The DUOTROL maintains high water level at a fixed point and correctly balances air pressure at that point after each pumping operation. It provides a maximum volume of water with a minimum of pump operation, saving power and reducing wear. Easy to install, stable adjustments. Ask for Bulletin D-6.

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"AUTOMATIC" also makes float operated controls: multi-circuit sequence type, multi-circuit program type, float switches, automatic alternators, and many special controls built to specifications.

AUTOMATIC CONTROL Company
1009 UNIVERSITY AVE., SAINT PAUL 4, MINNESOTA

Reader's Problems

(*Continued from page* 113)

Water-Operated Ejector Might Help the Trap

TO OBTAIN FLOW through *EEL's* bucket trap, a positive pressure differential must exist, that is, inlet pressure must be higher than outlet.

When a pressure of 12 psia exists within the heating system, atmospheric pressure causes air to flow into the system through the trap and, incidentally, air in the system greatly reduces its heating efficiency.

If it is possible to lower the trap below the oil separator so the present 3.5-ft inlet pipe length is increased to perhaps 8 ft, and if the discharge pipe is submerged below the liquid level in the sump, drainage should result.

If it is impossible to lower the trap and submerge the end of the discharge line, a water-operated ejector might be used at the end of the trap-discharge line.

Three Rivers, Mich. P L ULRICH

Install Backpressure Valve

WHEN EEL IS OPERATING his heating system at pressures below atmosphere, oil from the engine will certainly carry over to the heating system. This is because his hookup is not designed for operation at a vacuum. The bucket trap must have pressure above atmospheric to operate.

I suggest he install a gate valve on the heating main between oil separator and heating system provided there is an adequate backpressure relief valve.

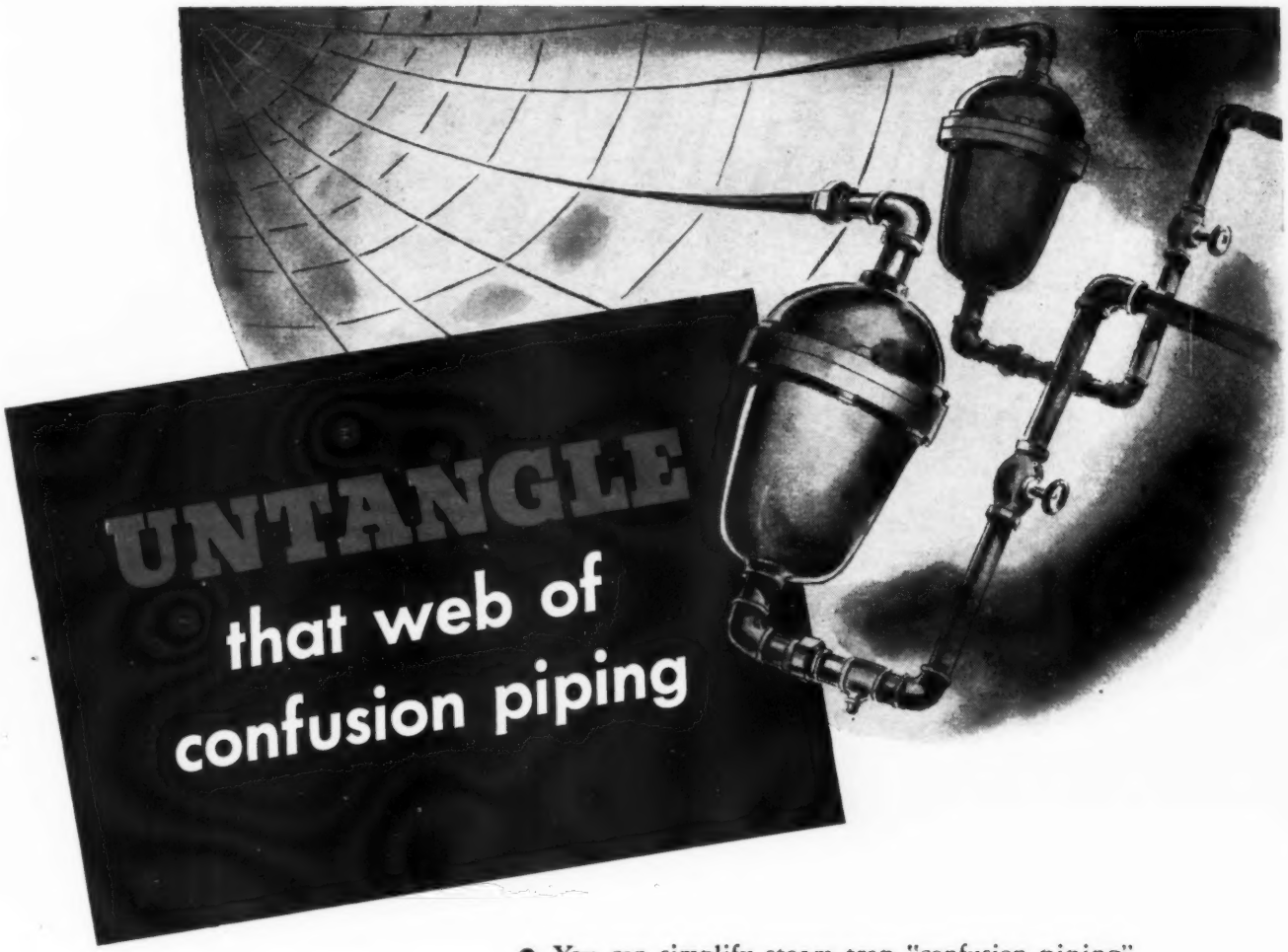
In mild weather this valve can be throttled to maintain a slight positive pressure on oil separator and trap. At the same time pressures below atmosphere will register on the heating side of gate valve.

We use the above arrangement at our plant and experience no difficulty with our oil separator.

Another factor in this arrangement is that the steam engine always has a backpressure.

Bronx, N. Y. ANTHONY GREER

MEXICO CITY (*McGraw-Hill World News*): A 3500-kw hydroelectric plant is under construction in the Stenquique gorge to supply energy for the kraft paper mill being built there and a 15,000-kw hydroelectric plant is planned for Quito about two miles away. Construction of the latter plant is to begin next year.



● You can simplify steam trap "confusion piping" with inverted bucket Super-Silvertops. There is no tangle when Anderson Super-Silvertops are used, for Super-Silvertops are connected *either* straight-in-line or as an elbow, using only one fitting, a nipple. That means you save on fittings and labor *besides* getting a clean-cut, confusion-free piping layout.

But, that's not all, Anderson Super-Silvertops give these advantages in a trap that is free of cored passages or split (pierced) gaskets—and that's important!

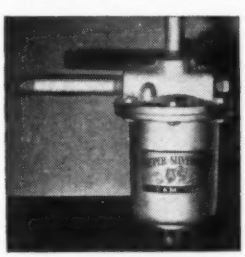
Super-Silvertops have been in use since 1932, are standard equipment in many "Blue-Book" industries and refineries . . . They are dependable and trouble-free for years.

Find out more about your savings with Super-Silvertop and simplified piping—write today for the descriptive folder, "Let's Raise the Blind On Steam Traps". This folder will help you choose a steam trap for your needs. Write for it today.

THE V. D. ANDERSON COMPANY
1934 West 96th Street • • • Cleveland 2, Ohio

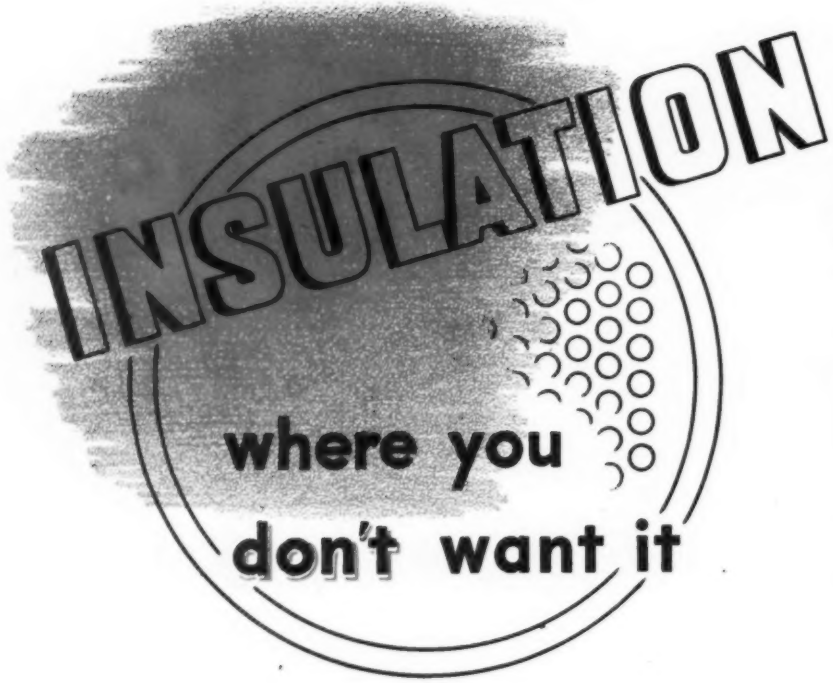
Do it the
EASY WAY

STRAIGHT- IN-LINE



AS AN ELBOW

SUPER-SILVERTOP STEAM TRAP



Insulation where you don't want it – and worse yet, where you can't see it – in the form of slime deposits on heat transfer surfaces, may be actually costing you thousands of dollars annually. A slime coating – even a film that's barely visible – will insulate condensers so they cannot function at rated capacity. And that may raise your producion costs disastrously.

Mechanical cleaning is not the answer. Not only is it a slow, laborious process, but it's costly to take condensers "off the line" periodically for this outmoded method of cleaning.

That is the reason so many plants are employing W&T Chlorination. Slime deposits already present are removed without shutdowns and their recurrence prevented, insuring a continuously slime-free cooling system.

Wallace & Tiernan chlorinating equipment is engineered to meet the specific needs of each individual plant, and W&T engineers will gladly recommend the most practical method of chlorine application for slime control in your plant.

WALLACE & TIERNAN
PRODUCTS, INC.
Manufacturers of Chlorine and Ammonia Control Apparatus
Belleville 9, N. J. • Represented in Principal Cities

CD-205

V-2 Rocket

(*Continued from page* 80)

the oxygen and enters the combustion chamber.

The second major fuel, ethyl alcohol, feeds into the annular space between the double walls of the spray cups to pass through its own orifices into the combustion chamber for intimate mixture with vaporized oxygen. Coolant alcohol after discharge from the annular rings adds to the mixture.

Starting Combustion. An electrical system, applied externally during launching preparations, ignites this combustible mixture. A centrally pivoted arm that carries four pyrotechnic candles of 10-sec duration is inserted into the chamber and upon ignition pinwheels around in a horizontal plane, shooting off flame and sparks. Gravity head on the main fuels pushes about 25 lb per sec of these fluids past pump rotors into the chamber. Upon proper combustion of this flow an estimated 17,000-lb test thrust develops and the turbine flow-control valves react to an impulse. Within a second the turbine reaches rated speed, still under remote control, enabling pumps to supply enough fuel to develop a 58,000-lb takeoff thrust.

Total ground firing-up time lasts about 3 sec. Once in the air, fuel consumption (oxygen-alcohol mixture) runs about 276 lb per sec. Gas products of this combustion, expelled at high velocity through the venturi nozzle, develop 64,000-lb thrust towards the end of the combustion period. This increase comes from reduced atmospheric pressure at the high altitudes and a greater acceleration of the fluids entering the chamber. Temperature of the oxygen-alcohol mixture during firing reaches 4802 F, but the cooling jacket and internal alcohol-cooling orifices combine to hold down chamber wall temperatures to a little over 1832 F.

Water Testing

(*Continued from page* 68)

inaccuracies refer to the average routine or plant control analyses. If greater accuracies are required they can be obtained through the longer and more tedious methods of analyses as performed in the laboratory.

"In considering the use of an analysis for control purposes, however, inaccura-

Buy the Best

DRY-TYPE TRANSFORMER!

FEATURES	Allis-Chalmers	Make "B"	Make "C"	Make "D"	Make "E"	Make "F"	Make "G"
Class "B" Insulation	YES	NO	YES	NO	NO	NO	NO
Light Weight, Compact	YES	NO	YES	NO	NO	NO	NO
Clamp Connectors	YES	NO	NO	NO	NO	NO	NO
Voltage Regulating Taps	YES	NO	YES	NO	NO	NO	NO
Conduit Knockouts	YES	YES	YES	YES	YES	YES	YES
Modern, Attractive Appearance	YES	NO	YES	YES	NO	NO	NO
Quiet Operation	YES	NO	YES	NO	NO	NO	NO

Compare leading makes. Only A-C's new Class "B" Insulated units give you all 7 important features!

☛ Class "B" insulation in Allis-Chalmers new Dry-Type Transformers reduces overall size as much as 1/3 over conventional Class "A" insulated types — reduces weight 22 to 38% — means wider range of installation... enables you to locate power almost any place you want it!

☛ These Class "B" insulated units require less mounting materials — eliminate insulating liquids and fireproof vaults — give longer service for no increase in cost over Class "A" insulated types... adding up to lower overall cost for you!

☛ For complete details get in touch with your nearby Allis-Chalmers dealer or sales office, or send for new bulletin B6382. ALLIS-CHALMERS, MILWAUKEE. A 2081

CLAMP connectors are a standard feature of the new Allis-Chalmers transformer. Gives anchor point for connecting either 480 or 240 voltages on both high, low voltage sides — means easier, faster installation for you!

SMALLER AND SAFER, these new improved units are priced as low as comparable Class "A" insulated types. You can choose from 14 sizes ranging from 1½ to 200 kva, single-phase and 10 to 300 kva three-phase.

ALLIS CHALMERS DRY-TYPE TRANSFORMERS

Years Mean Little to DARTS

2 BRONZE SEATS GROUND TO A TRUE BALL JOINT MAKE THEM LAST AND LAST

Darts don't die in a single service. Because of their two bronze seats, which are ground to form a true ball joint, they uncouple as easily as they close—may be used over and over again. Body and nut of high-test air-refined malleable iron are practically indestructible. Thus, in the long run, Darts cost least.

DART UNIONS

Ask your supplier to demonstrate Darts

E. M. DART MFG. CO., PROVIDENCE 5, R. I.

cies of one or two parts per million mean very little. Balances, for example, in a boiler water are maintained within certain limitations and such controls cover a wide range so that such errors of analysis in the methods used for control purposes would produce no harmful effect.

"Nothing said here is intended to minimize the need for as great an accuracy in a water analysis as possible. Great care should be exercised in making all determinations, but whatever small inaccuracies exist in the method of analysis itself are usually insufficient to cause difficulties in the control of dosages of the conditioning chemicals used.

"Always remember that parts per million as used in reporting a water analysis are quite different from percentage used in reporting most other forms of a chemical analysis. And also remember that greater accuracies are usually possible if absolutely necessary."

Incremental Costs

(*Continued from page* 78)

rially affecting the ratio of the costs.

For annual maintenance costs at 24.2% of annual fuel costs, as in Fig. 8, the corresponding incremental maintenance costs are shown as 20% of incremental fuel costs in Fig. 7.

Fig. 9 shows that on the basis of system annual costs plotted by the method of Fig. 2, the incremental maintenance cost is calculated at 20.4% of incremental fuel cost, which checks the 20% value computed before.

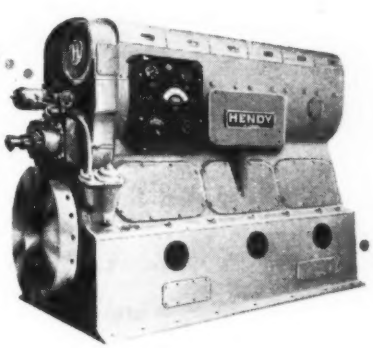
Most serious objection to use of annual production-cost statistics for incremental maintenance-cost determinations follows from the maintenance expenditure in a given period not necessarily resulting from generation in that period. Many intangible factors not capable of monetary evaluation are involved. However, production-cost records offer the only source of basic data and must be used for whatever they are worth.

Panhandle Eastern Pipe Line Co, Kansas City, Mo., was authorized by Federal Power Commission to export and sell to Union Gas Co of Canada, Ltd, Chatham, Ont., Canada, a maximum of 5,500,000 thousands cubic feet of natural gas yearly, provided that needs of present or future customers in the U. S. are first met. At the same time, the commission announced its order allowing Panhandle Eastern to construct and operate the required facilities to transport and sell the gas. Under the contract, Panhandle Eastern proposes to sell and deliver this gas to the Canadian company for 20 years.

before you spend thousands...

invest 3 cents

If you're looking for truly modern design in Diesel Power, be sure to check with Hendy before you buy. The new Hendy Diesel was designed to satisfy every demand of owner, engineer, operator and maintenance man... with no concession to usual standards or former models. **Write today for literature** describing the new Hendy Diesels and Diesel-electric sets... 127 to 780 hp... with generators from 75 to 500 kw. You can afford to compare... you can't afford not to.



Power by Hendy

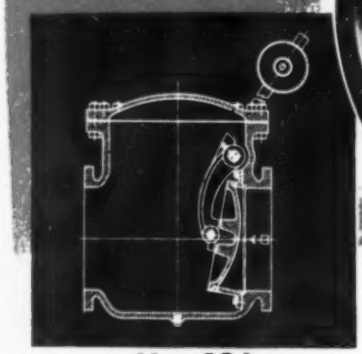
Joshua Hendy Iron Works • Est. 1856

Plants: **Sunnyvale and Torrance, California.**
Crocker-Wheeler Electric Division: Ampere, New Jersey.
Branch Offices: **Boston, Buffalo, Chicago, Cincinnati, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco, Washington.**

Quick, Positive Action

DAVIS TURBINE BLEEDER LINE NON-RETURN VALVES

- *Maximum Safety*
- *Sensitive Operation*
- *Unrestricted Flow*



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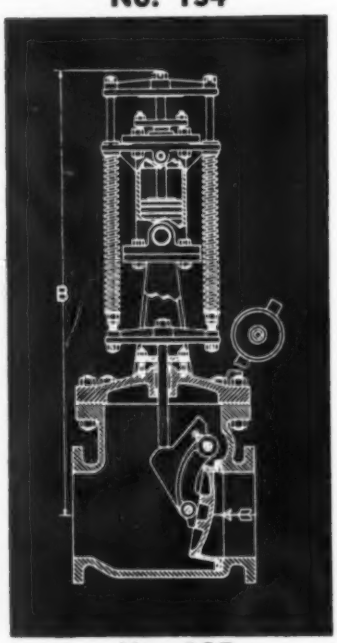


No. 135

The outstanding performance record of the Davis *"Straight Flow Type"* Non-Return Valve in modern power plant service is the direct result of:

1. Advanced Design
2. Quality Construction
3. Davis Service Recommendations

The counterbalanced swing check design illustrated here is widely favored because of its simplicity . . . visible action . . . straight line flow . . . full pipe size port area . . . very slight resistance to flow . . . sensitive operation . . . and easy accessibility of internal parts. Depending on service requirements, it can be furnished with outside oil dash pot for cushioning action. For turbine bleeder line service, a spring-loaded oil control cylinder can be added (as shown at lower left) for quick, positive closing on turbines equipped with automatic emergency (overspeed) steam shut-off hook-ups.

Check with Davis on your Non-Return Valve requirements. The Davis line is complete. Standard sizes from 4" to 24". For any pressure. Write for catalog and recommendations.

DAVIS REGULATOR CO.

2540 S. Washtenaw Ave., Chicago 8, Ill.

DAVIS VALVES

DAVIS REGULATOR COMPANY

Boiler Patches

(*Continued from page* 105)

clear why rectangular or square patches are never selected for an unstayed boiler shell. In a square or rectangular patch, two of the single-lap riveted sides form longitudinal joints.

For unstayed patches in solid plate not involving a girth seam, oval or diamond-shaped patches with the major axis in a girthwise direction are the proper choice. All corners should be rounded. If a patch is so long that it comes to an abrupt termination, for instance, at the closing-in line of an hrt boiler, a longitudinal joint of not more than four rivets is permitted. Should a defect be so extensive that this 4-rivet longitudinal joint cannot be followed, it is best to install a new course, or possibly a half course, of shell plate. In the event that a patch falls adjacent to a girth joint, select a triangular or crescent-shaped patch. The edges that are tucked into the lap of the girth joint are scarfed down for a neat fit.

Inside patches that overlap the shell plate add strength and avoid a pocket in which sludge may accumulate. However, two exceptions exist: (1) If a blowdown connection is included an outside riveted patch should be used to permit drainage of sediment. (2) If a patch involves a portion of the middle course, that is the smallest in diameter in a 3-course boiler, and if it includes the girth joint, the patch must of necessity be on the outside of the smallest course. Since such a patch tucks into the girth joint of a larger course, no pocket would be formed.

All patches so far discussed are for firetube boilers where heads are braced by stays and tubes. In watertube boilers whose heads are not so supported, resulting end stresses figure importantly in strengths of girthwise joints. Drums of water-tube boilers, however, are not subject to as high temperatures as shells of hrt boilers and so do not tend to bulge or develop defects requiring patching.

Orders have been placed by the British Columbia Power Commission for the second 25,000-hp hydroelectric generator for installation at the Campbell River development of the company, which is now under way. S R Weston, chairman of the commission, states that satisfactory progress is being made on the dam and power house at Campbell River, near Elk Falls, and that the two 25,000-hp units will commence operations in April, 1947. General Construction Co, Vancouver, Can., has the Commission's contract for the dam and power house.

Wire ahead

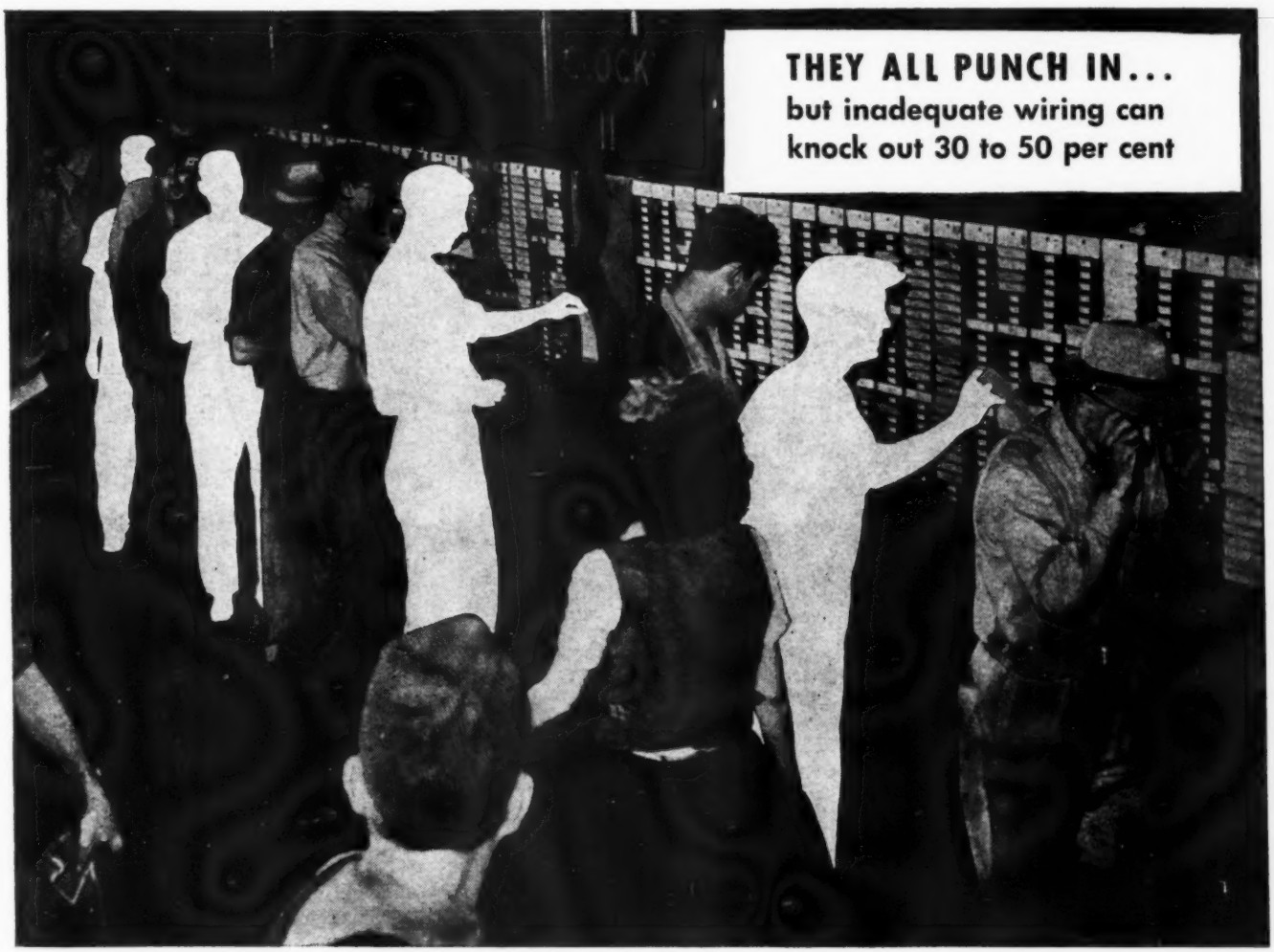
No matter how good a man is, he can't work *ahead* of his machine. And all too frequently overtaxed, over extended, obsolete wiring chokes off low-cost electricity from an efficient operator.

Is your plant safe against this threat to production and morale?

Why not check with your plant power engineer, your consulting engineer, electrical contractor or power salesman? It may save costly shut-downs and expensive alterations later.

Today, more than ever before, full production depends on adequate wiring.

FOR FULL PRODUCTION



ANACONDA **ANACONDA WIRE & CABLE COMPANY**

AJAX

FLEXIBLE COUPLINGS

Safeguard your direct-connected machines against unavoidable misalignment with the positive, resilient drive of Ajax Flexible Couplings.

Write for Data Book.

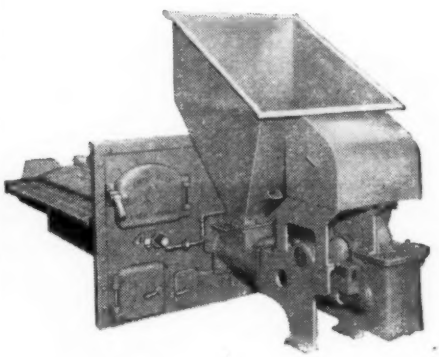
AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, N. Y.

New Equipment

(*Continued from page* 130)

mits built-in restitutional property of each ring to exert itself, thereby enabling rings to spring or contract instantly to normal. As a result, any "braking" action by the packing is prevented. This entire function is automatic and requires no attention from operator. No special adapter ring is required as top ring has a flat-top surface and 45-deg angle surfaces that accommodate any standard shape gland-follower.

Palmetto Pyramid packings may be used in any stuffing box for rotary as well as reciprocal action. Ring sets may be supplied in styles and grades to withstand oil, water and steam at any pressure and at temperature to 600 F. **Dept P, Greene, Tweed & Co, Bronx Blvd at 238th St, New York 66, N. Y.**



Underfeed Stokers

TYPE L RAM-DESIGN single-retort side-dump underfeed stoker is available for power boilers to 360 hp. *Type H* is of heavier design to carry loads up to the maximum usually required of a single-retort underfeed stoker. Both are available in a wide selection of lengths and widths. **Dept P, Erie City Iron Works, Erie, Pa.**

Temperature-Control Switches

FOR VARIABLE-SPEED MOTORS, temperature controls are in either 1- 2- or 3-switch models. Dial pointers and lock screws permit fixed temperature settings over an adjustable range up to 700-1000 deg. Maximum differential between switches is about 150 deg while operating differential is plus or minus ¼ to 25 deg. All models (E1, E2 and E3) are equipped with either sheet metal or vapor-tight cast-iron covers. **Dept P, Burling Instrument Co, 253 Springfield Ave, Newark, N. J.**

Pneumatic Tool Lubricator

FOR AUTOMATIC LUBRICATION of pneumatic equipment, the *CCA Lube* includes a transparent plastic window with O rings for top and bottom seals. Quantity of oil in lubricator is visible at all times. Lubricant regulation is by a needle valve on air outlet side. This regulator is adjustable to meet varying

(*Continued on page* 154)

Here's how to get best results from

NONPAREIL HD
DIESEL OIL

DIESEL OPERATORS have had such excellent results with heavy duty oils that some operators have concluded these oils will stand up under any and all conditions. These oils certainly will stand up under severe use and a certain amount of abuse. But it doesn't pay to go too far in the matter of abuse.

You can get longer engine and oil life, lower maintenance and replacement costs by using Nonpareil HD Diesel Oil and by observing the few precautions listed here. A Standard Oil Lubrication Engineer will help you test Nonpareil HD and take full advantage of its clean, wear-reducing operation. Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

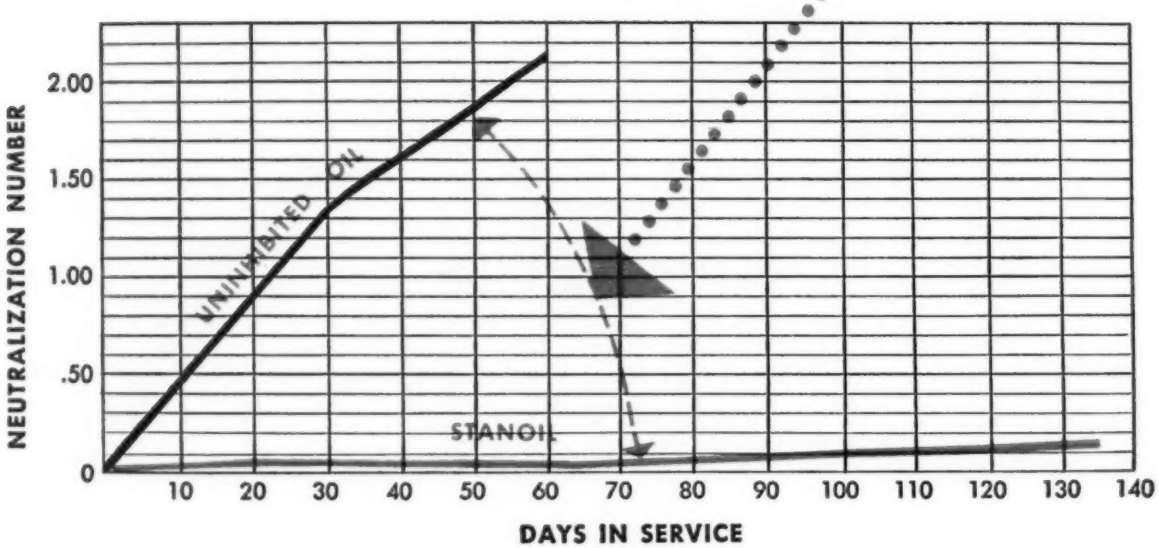
Don't remove additives by severe filtration. Best results cannot be obtained from Nonpareil HD, or other truly heavy-duty oils, when adsorbent type filters are used. Fuller's earth or similar clay-type filter materials soon clog. They also tend to remove the additives which give heavy-duty oils their superior detergent and oxidation inhibiting properties. But filter manufacturers can supply you with filter materials which will clean Nonpareil HD Diesel Oil without premature clogging or excessive additive loss.

Don't attempt to restore color to used oil. Heavy-duty oils darken rapidly in service and cannot be satisfactorily restored to their original color. Detergent oils possess the ability to carry in suspension very fine particles which cannot be completely removed by filtering. The particles which remain in the oil after filtering are microscopic, and do not impair performance of the oil. Normal make-up oil, plus proper filtering, will maintain effective detergency in Nonpareil HD for long periods of time.

Don't overheat oil during filtration. In an effort to speed up filtration, high filter operating temperatures—as much as 350°F. to 400°F.—are sometimes used, particularly with clay-type units. Regardless of whether heavy-duty or the older type oils are being filtered, excessive temperature is harmful to Diesel Oil. It results in high filtration losses, oil oxidation, and impaired oil stability.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Here's the difference between uninhibited oils and Improved STANOIL



Oil lasts longer in gear cases . . . in bearings . . . in compressors . . . and hydraulic systems

THE CHART above shows the operating record of two oils in a speed reducer on an induced draft fan. Operating conditions were severe, as the fan ran 24 hours a day—so severe that a straight, uninhibited oil lasted only 60 days before acidity reached 2.15 mg.KOH/gm and the oil had to be replaced.

This was one spot chosen to test Improved STANOIL—a high quality mineral oil to which an oxidation inhibitor is added. The second curve shows the results. After 135 days of operation the neutralization number of the oil did not go over 0.15.

Deposits, corrosion and acidity caused by oil oxidation have been reduced in service tests on all types of equipment. A Standard Oil Lubrication Engineer will be glad to give you further information on Improved STANOIL and suggest installations in your plant where this oil can save machine down-time, oil replacements and wear. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Headquarters for the

MOST COMPLETE LINE

of DROP FORGED STEEL VALVES, FITTINGS & FLANGES

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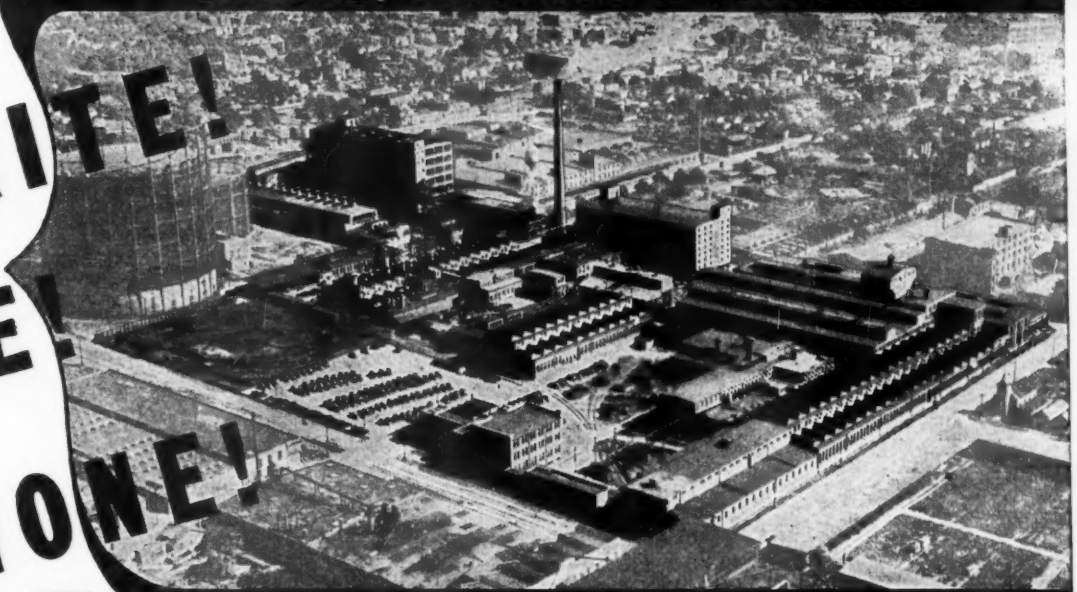
WIRE!

PHONE!



Air View of Henry Vogt Machine Co. Plant, Louisville, Ky.

Send for copy of Catalog F-8

VOGT provides one convenient, economical source of supply with the most comprehensive line of drop forged steel piping materials anywhere available to industry. Here will be found everything needed for the safe and efficient control of oil, steam, water, air, gas, and ammonia at high or low pressures and temperatures.

More drop forged steel Valves, Fittings and Flanges are made by Vogt, and deservedly so, because Vogt makes them better!

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Whatever you need to keep your business rolling — you've *got it* in just a matter of hours when you get it by Air Express.

Yes, delivery speed by air is so fast, it's the next best thing to having your supplier's warehouse right next door.

Rates are drastically down from prewar days — a new economy that makes this service a greater money-maker than ever for thousands of firms throughout the nation.

Specify Air Express-a Good Business Buy

Shipments go everywhere at the speed of flight between principal U. S. towns and cities, with cost including special pick-up and delivery. Same-day delivery between many airport towns and cities. Fastest air-rail service to and from 23,000 off-airline communities in the United States. Service direct by air to and from scores of foreign countries in the world's best planes, giving the world's best service.

RATES CUT 22% SINCE 1943 (U. S. A.)					
AIR MILES	2 lbs.	5 lbs.	25 lbs.	40 lbs.	Over 40 lbs. Cents per lb.
149	$1.00	$1.00	$1.00	$1.23	3.07¢
349	1.02	1.18	2.30	3.68	9.21¢
549	1.07	1.42	3.84	6.14	15.35¢
1049	1.17	1.98	7.68	12.28	30.70¢
2349	1.45	3.53	17.65	28.24	70.61¢
Over 2350	1.47	3.68	18.42	29.47	73.68¢
INTERNATIONAL RATES ALSO REDUCED					

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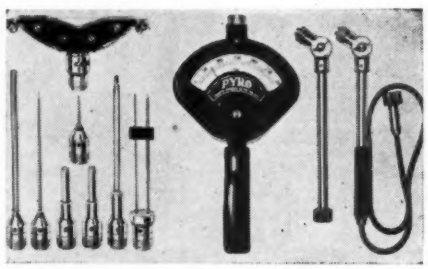
equipment requirements. Filler cap and adjusting aperture are located directly above regulator valve. As *Lube* works only with air-operated equipment, device is fully automatic, permitting only correct amount of oil to mix with working air.

Its output is 75 millivolts and internal resistance less than 1 ohm. It may be connected directly to standard indicating instruments that are rugged, inexpensive and portable. Several pickups may be connected together in parallel. **Dept P, CCA Products Engineering, Box 671, Glendale, Calif.**

Air Hose

MANUFACTURED IN light-, medium- and heavy-duty types providing a wide range of adaptability to various jobs, air hose is said to have unusual strength and flexibility. Hose is an outgrowth of the wartime process used in making bullet-sealing fuel hose for airplanes. According to the company, the hose is manufactured under an exclusive method of bonding cover, carcass and tube together. **Dept P, Goodyear Tire & Rubber Co, 1144 E Market, Akron, O.**



Surface Pyrometer

CONSTRUCTED IN A SHOCK, moisture and dust-proofed shielded steel housing, *Pyro* surface pyrometer is immune to external magnetic influences. Large 4¾-in.-dia indicator with a 4-in. direct-reading scale provides ease in reading temperatures quickly and accurately. An internal automatic cold-end junction compensator is standard equipment with this instrument.

A choice of eight different thermocouples and two extension arms, all instantly interchangeable without adjustment or recalibration, together with a selection of five different temperature ranges from 0 to 300 F and 0 to 1200 F, makes this instrument ideally suited for any metallic or nonmetallic surface temperature problem. **Dept P, Pyrometer Instrument Co, 103 Lafayette St, New York 13, N. Y.**

Band Saw Guide

ADJUSTABLE TO BLADES ¼ to 1½ in., band saw guide and metal safety guard are adapted to metal and plastics, as well as wood. Side guide wheels are mounted in a staggered position to eliminate binding and a grooved back wheel holds saw in position. Positive adjustment of mounting arm on supporting bracket is by a set screw that exerts pressure against a 90-deg pin that in turn presses against adjusting screw. This eliminates any tendency to loosen or creep.

A special 10-in. socket wrench is provided for the set screw and adjusting screw to move

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Importance of Protective Film in Extending Condenser Tube Life

The character of the corrosion film which forms on condenser tubes during service is influenced primarily by the nature of the circulating water and the chemical composition of the alloy or metal from which the tubes are made. In general, corrosion films which form on brass are more easily removed than those formed on modified brasses, aluminum bronzes and copper-nickel alloys. The rate of film removal depends upon the temperature, velocity (extent of agitation), and of course the specific properties of the corrosive medium. Hence the nature and distribution of the corrosive film—whether it is continuous and impermeable, or permeable, with physical and chemical properties markedly different from the metal being corroded—has a tremendous influence on the rate of corrosion.

Two Types of Corrosion Films

Let us consider the corrosion films which form as belonging to two different classes—the invisible (frequently protective) and the visible (frequently non-protective). In between these two extremes are corrosion films which have varying degrees of protective values.

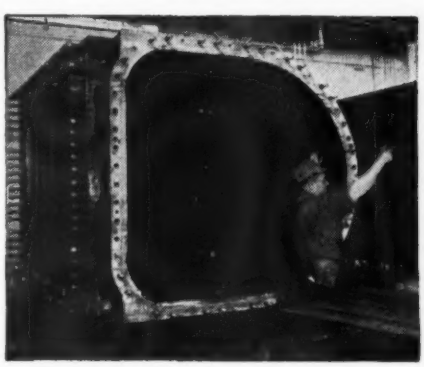
It has been observed repeatedly that the visible films, which are insoluble in the corroding medium, usually have the following characteristics: They are permeable to water (they permit the passage of a fluid through them). They are sufficiently dense to impede the flow of fresh corrosive solution to the metal surface (this may also slow up the rate of corrosion). They may be non-uniform or discontinuous, thus permitting the corrosive solution to come in contact with metal in certain areas and partially screen the metal in others. The corrosion may be increased in certain screened areas (under or around) by the formation of concentration cells. The metal under the thicker portions of partially permeable film usually becomes pitted (anodic area) or attacked by localized corrosion. The exposed metal or those areas covered with thinner films are only slightly corroded (cathodic area). The continuous accumulation of corrosion products of the same type helps to produce deeper pits or to enlarge the area being corroded.

The properties of visible corrosion films aid in the formation of the concentration cell (metal ion and oxygen) types of corrosion. The concentration cell begins to operate when the corroding substance is present in different concentrations at adjacent areas on the metal surface.

Foreign Matter Accelerates Corrosion

The nature and distribution of sand and slime from various growths, weeds, leaves, silt, ashes, sheels, ruts, etc., are also very important contributors to cell types of corrosion. When foreign materials of this nature contribute towards localizing corrosion, the resulting attack is commonly called "deposit attack."

It is known by power plant engineers that the removal of such debris by periodic cleaning using rubber plugs, bristly brushes or high pressure water or air applied at the exit end definitely prolongs the life of condenser tubes. The water box should be cleaned regularly and the paint should be kept intact. Of course, the intake tunnel should be kept clean and if necessary the channel should be dredged. If troubled with marine growth and slime, chlorination may be used. In all instances the metal is corroded (anodic area is pitted or dezincified) where the oxygen concentration is least, viz., where the corrosion film is thickest or under deposits of foreign material which may eventually become part of the corrosion scale. Where a thin deposit covers the metal (cathodic area) and therefore the oxygen concentration is the highest, the least amount of corrosion occurs.



7500 Square Foot Surface Condenser, courtesy Allis-Chalmers Manufacturing Company

Superior Corrosion Resisting Alloys Available

In such alloys as Cuzinal (aluminum brass), Duronze IV (aluminum bronze) and 70-30 copper-nickel, exposed to clean ocean water, the corrosion films are comparatively thin and of a more protective nature. Such films adhere more firmly to the parent metal and are more readily healed when bruised. Consequently the chance of localized corrosion (pitting) is reduced.

Besides reducing corrosion, the thinner corrosion films also possess better heat transfer characteristics than the thicker corrosion films and scales. This results in greater efficiency.

It follows therefore that there is a relationship between the character of the film and condenser tube life. Since the character of this film varies with the alloy and the corrosive environment it behooves every power engineer to seriously consider the superior qualifications of the more modern condenser tube alloys.

Preventive Measures Should Be Taken

Numerous devices have been designed, built and put into practical use to remove debris, entrained gases, and other substances from corrosive waters. The simplest device is the stationary screen which is quite effective within its limits. The rotating screen is widely used and is generally more satisfactory than the stationary screen since the debris, fish, sea weed, etc., are continuously being removed automatically.

The use of a wide generous tank with ample baffles is of proven effectiveness in removing debris and entrained gases. This is accomplished by using a tank which is considerably wider than the incoming stream of water. This slows down the flow sufficiently to allow the foreign matter to settle out from the water and the gases to rise and escape. The use of such tanks materially aids in increasing condenser tube life. It follows that condenser maintenance is appreciably reduced since less debris gets into the water box and the tubes themselves.

Field Tests Strongly Recommended

Many power engineers are looking into the possibilities of these alloys through the installation of test lots under actual service conditions or as field tests so that they will have available pertinent information as to the best alloys for their particular requirements or operating conditions. Here our Technical Service Department can be very helpful in working with power engineers in the selection of the alloy which will be most practical. If you do not have a copy of our Condenser Tube Manual, write for it today.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Now in production in our Philadelphia factory.

with a

Midget "Megger"* INSULATION TESTER

Making important check tests of insulation resistance is a one-man job with any type of "Megger" Insulation Tester. For example, the illustration shows our Midget type being used for a periodic test on one of a group of fire-pump motors. After making connections, the operator merely turns the crank of the hand generator—and reads resistance directly on the scale. It is done as simply and quickly as the telling.

The Midget "Megger" Tester is ideal for maintenance and trouble-shooting because of its light weight, small size and ready portability. The hand-cranked generator makes it independent of batteries or external power supply—it is instantly ready for testing insulation resistance of almost any type of electrical equipment. Reads up to 50 megohms and delivers 500 volts d-c. Supplied also in ratings of 10 megohms, 100 volts and 20 megohms, 250 volts.

For periodic maintenance tests or where trouble has occurred the Midget "Megger" Tester has won wide favor with the men who use it. Its low cost has been attractive. For complete description write for Bulletin 1785-P.

** By special arrangement with the British makers of "Megger" instruments our American-made models carry the U. S. Registered Trade-mark "MEGGER".*

JAMES G. BIDDLE CO. • 1316 ARCH STREET PHILADELPHIA 7, PA.

grooved wheel in and out for various width saws. While saw is running, minor adjustments may be made with a No. 4 wrench. Two other models of the same design are available for the smaller-sized saws. **Dept P, Boyer-Campbell Co, 6540 St. Antoine St, Detroit 2, Mich.**

Control Cabinets

INSULATED VARIABLE TEMPERATURE and humidity cabinets are for simulation and control of different atmospheric conditions. Units duplicate accurately, according to maker, any desired combination of temperature, humidity and air circulation.

A simple setting of controls brings cabinet to a new equilibrium within 10 to 15 min. Cabinets are in laboratory and production sizes. Glass doors permit inspection of contents. **Dept P, Tenney Engineering, Inc, 26 Ave B, Newark 5, N. J.**

Air-Control Valve

PURPOSE OF SPEED-CONTROL VALVE is to provide full range of selectivity in the volume of air, thereby giving split-second control of piston speed of pneumatic equipment on which it is used. Air flow from cylinder to operating valve is said to be regulated with precision, in either small or large volume, changes taking place with smooth progression. There are only two moving parts—stem and poppet—with stem shaped to form a venturi for passage of air in small volume. **Dept P, Ross Operating Valve Co, 6477 Epworth Blvd, Detroit 10, Mich.**

Threading Tools

NEW LINE of standard carbide-tipped threading tools, *Style T-15*, has been added to stock. Tools are 60-deg V-nose design. Tips are of Carboloy, Grade 78-B, a tough and wear-resistant grade of carbide, particularly suitable for long-run threading of steel parts.

Shank sizes include ⅜- ½- ⅝- and ¾-in.-sq styles. Shank lengths run from 2½ to 4½ in. Primary clearance at nose of tool is 3 deg, with a secondary clearance of 6 deg. This design provides free cutting while insuring ample support for nose of tool tip. Two smaller sizes of threading tools are packaged in standard lots of twelve each; the two larger sizes in packages of six tools each. **Dept P, Carboloy Co, Detroit, Mich.**

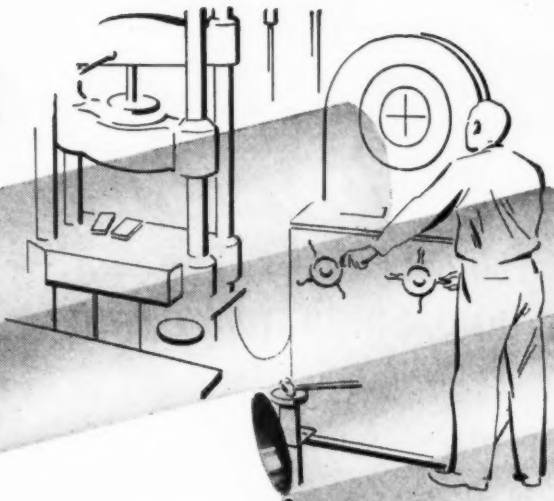
Cutting Electrodes

BY ADDING a tank of bottled oxygen, *Ellpro* cutting electrodes can serve with any portable electric-welding set. Upon opening the valve to start the oxygen jet and touching the electrode tip to the work with a slight wiping action, an arc is established that instantly starts cutting. There is no need for preheating. Electrode is held in starting position only long enough to heat and pierce the metal; then the electrode is moved in direction of desired cut.

The electrodes are for fast, safe cutting under water, as oxygen is not explosive. They are used successfully on either ac or dc with any standard welding generator or trans-

Scientific SAFEGUARDS

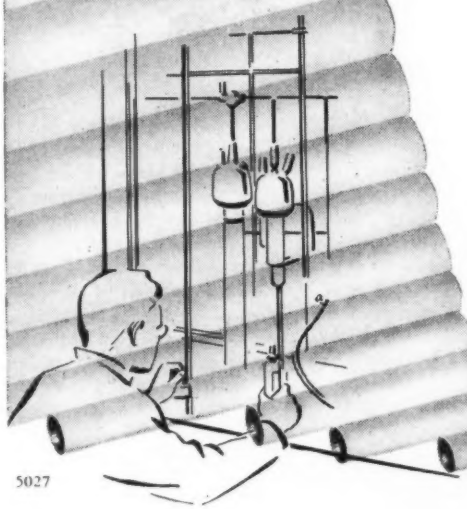
. . . to assure uniformity and quality in steel tubes

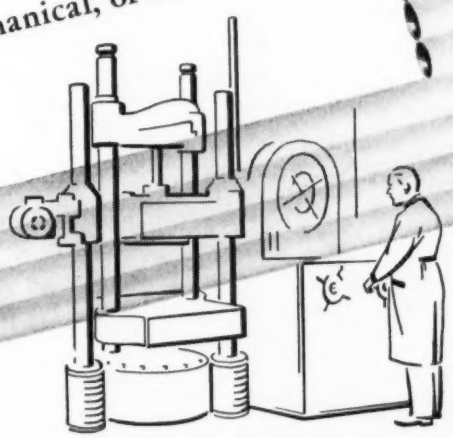


GLOBE TUBES

Extra care in production control assures uniformity and quality in all classes of Globe steel tubes. Unvarying quality is safeguarded and production methods and materials exactly controlled by one of the largest and complete chemical and physical laboratories of its kind, concentrating on tubing characteristics and problems.

You can be sure of uniformity and quality when you specify Globe tubes — pressure, mechanical, or stainless.





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GLOBE STEEL TUBES CO.

Milwaukee 4, Wisconsin, U. S. A.

★ PRESSURE TUBES ★ CONDENSER & HEAT EXCHANGER TUBES ★ GLOBEIRON HIGH PURITY IRON SEAMLESS TUBES
★ MECHANICAL TUBING ★ GLOWELD WELDED STAINLESS STEEL TUBES ★ SEAMLESS STAINLESS STEEL TUBES

Keeps rust out—keeps heat in

B-H NO. 1 INSULATING CEMENT

A special rust inhibitor, in this insulating cement, keeps metal surfaces free from corrosion. No rust can form—even when

the cement is allowed to dry out slowly on cold equipment.

The basis of B-H No. 1 Cement is nodulated *black* Rockwool. Although applied with water, the nodules remain unchanged—insuring full insulating efficiency. This cement withstands temperatures up to 1800° F. under the most humid conditions.

It can be stocked without breakage or loss, is easily applied even by an unskilled laborer, and is fully reclaimable when used at temperatures not exceeding 1200° F.

In *every* way B-H No. 1 Insulating Cement is ideal for maintenance work, especially for valves, fittings and irregular surfaces, large or small, and as a finish over blanket and block insulations.

The coupon below will bring you full information and a practical sample of B-H No. 1 Cement.

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SPECIALISTS IN THERMAL INSULATION PRODUCTS

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Send information on products checked below:

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- ☐ No. 100 Pipe Covering—effective up to 1200° F. (for long runs overhead, underground, Diesel exhausts)
- ☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.
- ☐ Black Rockwool Blankets (felted between various types of metal fabrics)

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former. All are 14 in. long and covered with an adhesive pulp base to provide a clean burn-off rate. Cutting rates range from 35 in. per min, through ¼-in. plate, to 20 in., through 1-in. plate, with corresponding electrode burn-off rates of 1⅞ and 1⅛ in. **Dept P, Ellwood Products Corp., Ellwood City, Pennsylvania.**

Safety Valve

MR-2 SAFETY THERMOVALVE is a safety device for gas-control applications. Unit handles manufactured, natural or LP gases and is designed for such service as space and unit heaters, central and floor furnaces, water and range heaters and steam boilers. Device has a sealed electromagnetic assembly, heavy-duty ⅛-in.-round thermocouple, flexible armored cable leads and a visual valve position indicator.

Necessary valve operating current is supplied by heat of pilot flame applied to thermocouple element. Flame failure automatically closes valve. Pushbutton reopens it. **Dept P, General Controls, 801 Allen Ave, Glendale 1, Calif.**

Idling Device

TO SAVE GASOLINE and prolong engine life, Hobart FW-1400 mercury idling device automatically shuts down gasoline engine to idling speed 12 to 15 sec after operator has stopped welding. To bring engine to normal welding speed, operator merely strokes the arc. Idling device and governor are linked with throttle in such a way that throttle can be closed without having to resist governor action. When welding, governor controls engine speed without any interference from idling device. It can be made inoperative by opening an off-and-on toggle switch without affecting welder or gasoline-engine operating characteristics. **Dept P, Hobart Bros Co, Troy, O.**

Silver Brazing Flux

NU-BRAZE WONDERFLUX No. 4, a silver brazing flux, melts and forms a protective coating over surfaces at 480 F, well below oxidation temperatures of most metals. This material has a pH of 5 to 6; it can be painted on parts and allowed to remain for long periods without producing corrosion. It contains no free chlorides and does not release objectionable volumes of noxious fumes.

At 800 F this material is said to be water thin, capable of flowing through clearances as close as 0.001 in. After melting it hardens to an extremely brittle glass-like scale that can be removed easily with either hot or cold water, or jarred off. **Dept P, Sherman & Co, 197 Canal St, New York, N. Y.**

Protective Coating

COTOID is a new protective coating, highly resistant to acids, alkalies, chlorides, oils, brine, oxygen, gasoline and alcohol solutions. This is a recently developed formula based on synthetic resin, a thermoplastic, in which its low water and inert properties inhibit corrosion. Application of *Cotoid* results in a tough, hard, elastic finish, which after air- or forced-drying, is tasteless and

FASTER . . . MORE EFFICIENT . . . MORE ECONOMICAL

HYPRESSURE Jenny STEAM CLEANER

With The

New ADJUSTA-BLAST-GUN*

FOR EVERY INDUSTRIAL CLEANING JOB

HYPRESSURE JENNY STEAM CLEANING is the *fastest,* most *thorough,* most *economical* method known for cutting and flushing oil, grease, and dirt, from any surface. Cleaning is accomplished by a highly atomized mixture of steam, hot water and cleaning compound applied under pressure through the ADJUSTA-BLAST-GUN, a light, compact unit which gives the operator instant choice of the right type and the right amount of spray or water for any cleaning requirement. One man, using HYPRESSURE JENNY, can do more cleaning in an hour than 8 men can accomplish in the same time by outmoded hand cleaning methods.

JENNY has many uses and is a time and money saver in any plant or factory. For instance, JENNY STEAM CLEANING of machinery *before* repairs, cuts "down time" practically in half by saving up to 40% of mechanics' time usually lost wiping oil and grease from tools and equipment. JENNY also keeps mill and factory floors clean for safe, rapid plant traffic . . . provides better light by cleaning windows, walls, and skylights . . . lessens fire hazards.

Hundreds of manufacturing plants have adopted HYPRESSURE JENNY as the *fastest, most efficient,* and *most economical* method of doing all their cleaning jobs. There is a JENNY model to suit *your* needs, too. Why not let us send you detailed information and new low prices on JENNY STEAM CLEANERS and JENNY Cleaning Compounds?

*The ADJUSTA-BLAST-GUN

Present HYPRESSURE JENNY users will welcome the new ADJUSTA-BLAST-GUN, because it provides, in one light, compact unit, instant choice of the RIGHT type of spray for most any cleaning job. The operator, at all times, has, right at his finger tips, adjustable control of a spray which may be varied anywhere from HYPRESSURE JENNY'S powerful steam vapor spray for grease and dirt removal, up to an extra powerful 480 gallons per hour flushing or rinsing blast for removing stubborn mud and clay deposits, melting snow and ice, etc. And again, if you want a cold water rinse, a turn of the valve does the trick.

An ADJUSTA-BLAST-GUN, added to your HYPRESSURE JENNY, more than doubles the amount of cleaning work that you will be able to do, at NO INCREASE in the amount of fuel and electricity consumed, and with no mechanism added to the machine. ADJUSTA-BLAST-GUN, price complete, delivered **$35.00**

Hypressure Jenny Division

HOMESTEAD VALVE MFG. CO.

P. O. BOX 210 CORAOPOLIS, PENNA.

Nothing Slips by the..

HENSZEY FLOW INDICATOR

This accurate instrument goes into action as soon as the first fluid starts to pass through. It registers any rate of flow from zero to 100 per cent — instantly and accurately — as it occurs.

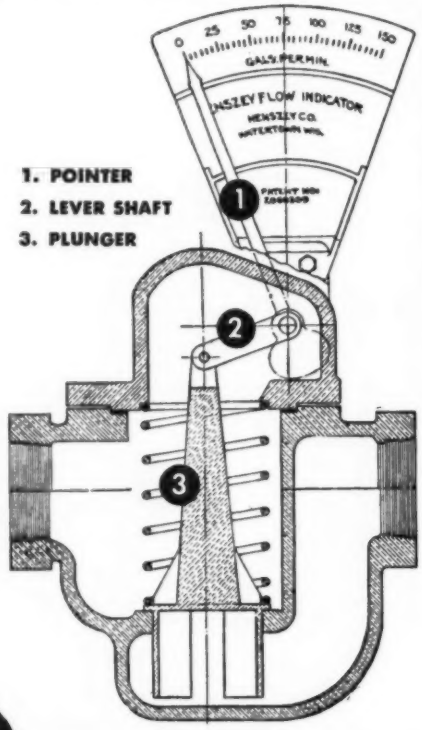
If your manufacturing process demands an accurate check on the rate of flow of liquids such as boiler feed water, condensate, gasoline, light oils, free-running chemicals etc. — plan now to investigate the Henszey Flow Indicator.

Send for special bulletin FI-1.

HENSZEY COMPANY, Dept. D-7, Watertown, Wis.

There are only three moving parts in the Henszey Flow Indicator—the Pointer, the Lever Shaft and the Plunger. And that means longer wear, continued service, and constant accuracy.

The liquid enters the indicator below the plunger, forcing the plunger upward. Slots in the side of the plunger allow the liquid to pass. Increased flow will increase the lift, exposing a greater area of the slots, so that the lift of the plunger is in direct proportion to the rate of flow of the liquid. The graduations on the dial are uniformly spaced from one end to another and read direct — without constants. The entire instrument can be installed right in the pipe line.



1. POINTER
2. LEVER SHAFT
3. PLUNGER

HENSZEY

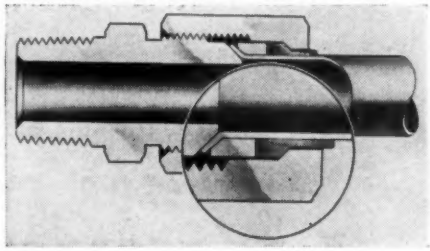
FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

odorless. It has been found practicable for protecting walls, wood- or steel-structural work. It is suitable for coating inside and outside surfaces of concrete, steel or wooden tanks. It serves with a wide range of acids, gasoline, sour crudes and lye solutions.

Cotoid withstands a maximum temperature in air or vapor of 220 F. Maximum submerged temperatures approach 150 F. It is claimed not to crack under temperatures as low as 20 F below zero.

Application by spraying is recommended. Apply by dipping, flowing or roller coating. A specially prepared *Cotoid* for baking-on process is available. *Cotoid* comes in 1-, 5- and 10-gal cans and in 55-gal drums. **Dept P, Lithgow Corp 333 W 40th Pl, Chicago 9, Ill.**



Tube Fittings

KNOWN AS GRIP TUBE, fitting incorporates a heat-treated sleeve the rear end of which is slotted to form spring fingers. Tightening of nut forces forward end of sleeve against tube flare, sealing the fitting. Further slight tightening of nut contracts segmental fingers of sleeve around tube, thus gripping tube uniformly. It is claimed that the heat-treated sleeve and flare seal joint withstand pressures in excess of tube ratings; also that tube does not expand at the flare nor the sleeve expand in tightening, thus avoiding jamming of sleeve within nut. Tube fittings, in ¼- to 2-in. tube sizes, may be reused repeatedly. Nut slides around short tube turns, which allows fittings to be applied in close quarters. **Dept P, Flodar Corp, 331 Frankfort Ave, Cleveland 11, O.**

Paint-Brush Cleaner

WITH COMPACT ELECTRIC TOOL, it is possible to use the same brush and change from red to white paint in less than 90 sec, according to maker. Easily operated tool also drills small holes, mixes paints and cleans stippler covers. It has a rustproof finish; is operated on ac or dc current. **Dept P, Nashaway Co, Chicago, Ill.**

Bottle Oiler

AUTOMATIC VIBRATING-ROD bottle oiler is refilled without removal from its installation and is furnished in an unbreakable construction in a wide size range. Oiler serves on plain sleeve bearings, line-shaft bearings, jack shafts, spindles where light- or medium-bodied oils are satisfactory. It is especially suitable for dusty surroundings.

Oil is fed from an airtight reservoir through an oilport to a feed rod, which slides freely in a closely fitted hole in base and rides lightly on journal. A slight vibration

Here's the Inexpensive Tool for cutting your gaskets quickly and easily!

You need the ALLPAX GASKET CUTTER *Now!*

SAVES MATERIAL, TIME AND LABOR.

In actual, every day service, the "ALLPAX" has shown savings of 25% in material plus a tremendous saving in time and labor.

OUTSTANDING IN HIGH EFFICIENCY

This remarkable tool replaces slow, laborious methods of cutting gaskets with a simple, foolproof mechanical method of cutting which can be operated by anyone in the plant. It will pay for itself in the first few gaskets cut and effect savings every time it is used. The sooner you use it the quicker you'll save.

MADE IN U.S.A. BY A PACKING MANUFACTURER FOR PACKING USERS.

Because ALLPAX knows the problems that confront packing users, our engineers were well qualified to develop a Gasket Cutter that would meet all requirements in a way that would be an outstanding improvement over old methods. Reports from hundreds of users as well as wider and wider recognition and acceptance everywhere confirm all claims made by us that the "ALLPAX is one of the most remarkable tools ever invented" . . . and can be used with outstanding advantage wherever packing is cut for application.

CUTS CLEAN GASKETS FROM 1" TO 36" IN A JIFFY . . . FROM ANY MATERIAL.

Whatever the gasket material . . . compressed asbestos sheet . . . rubber . . . duck . . . canvas . . . cork . . . felt . . . cardboard, etc., the "ALLPAX" cuts gaskets faster, cleaner and more accurately than is possible by any old fashioned hand method. Furthermore, it will cut gaskets from 1" to 36" in diameter with any width flange.

COMPLETE . . . READY TO USE

The ALLPAX GASKET CUTTER is furnished complete with six (6) double-edge cutting blades and one (1) 18" varnished wood cutting board . . . all packed in a convenient, durable hardwood case with hinged cover . . . everything needed and ready for any job of gasket cutting. Price $19.50 for the complete equipment, f.o.b. Mamaroneck, N. Y. ORDER NOW!

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Kindly send further information on the "Allpax Gasket Cutter"

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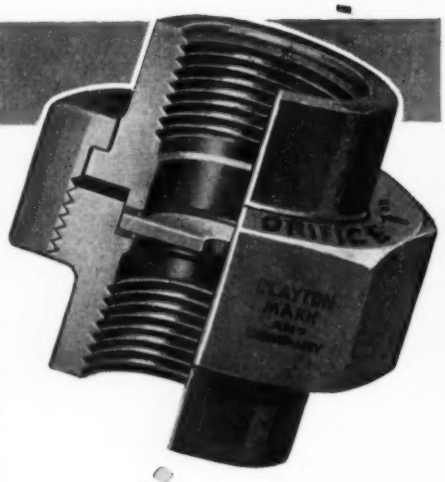
FORGED STEEL UNIONS

Orifice

A SIMPLE, EASY-TO-HANDLE, MODERATELY PRICED, ORIFICE UNION.

Ideal for flow control of Steam, Oil, Ammonia, Water, Gas and Air. Also for metering and measuring. 600 lbs. S. W. P. or 2000 lbs. C. W. P. The ORIFICE plate is furnished in cold rolled 18-8 stainless steel. ORIFICE plate and gaskets are set in a groove of solid steel to safeguard against blowing of gaskets and resultant trouble. The ORIFICE union has extra heavy ends and nut with the nut threads permanently lubricated.



SIZES ¼" TO 3"

Petro

SIZES ⅛" TO 3"

AMERICA'S MOST UNIVERSALLY USED UNION

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

A PARTIAL LIST OF PROVEN SERVICES

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is Used.

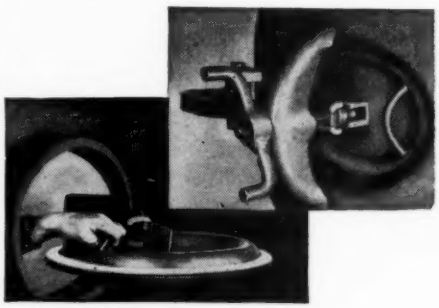
ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS SINCE 1912

WRITE FOR PAMPHLET AM-67 • ORDER BY TRADE NAME FROM YOUR JOBBER

CLAYTON MARK & COMPANY

1900 DEMPSTER STREET • EVANSTON, ILLINOIS

is caused by the directional drag of rotating shaft on feed rod, resulting in a pumping action. As bearing becomes warm, heat is conducted through rod to reserve oil, causing air in reservoir to expand. Pumping and thermal action forces oil to creep slowly down feed rod to bearing. Since feed rod is lubricated where it rides the shaft, there is no wear on shaft. When shaft is not in motion, vibration of feed rod ceases, bearing cools down and flow of oil stops. **Dept P, Oil-Rite Corp, 3478 S 13th St, Milwaukee 7, Wis.**



Manhole Cover

SIMPLE BUT ADEQUATE SUPPORT DEVICE, with Lenape standard, elliptical manway covers, permits such covers to be manipulated and withdrawn through the opening and swung aside on extension of the vessel. These manway covers are in standard sizes for 10x15 to 18x24 in. and serve where manways are required for frequent access. They can be made in carbon and stainless steel. **Dept. P, Lenape Hydraulic Pressing & Forging Co, PO Box 21, West Chester, Pa.**

Impact Wrench

THOR PNEUMATIC IMPACT WRENCH drives and removes nuts, bolts and cap screws up to ⅜-in. thread size. It introduces a new theory of impact mechanism to provide the tool's full striking power longer on steady production, assembly or maintenance. Rotatively striking impact jaws, set at a wide radius from spindle center to reduce stress, and a short, rigid spindle shank, which delivers the blow close to the work, are the principles in the new *Thor* impact mechanism. Elimination of fastenings in the mechanism and compact, streamlined design of housings reduce weight to 3¾ lb and length of tool to 5⅞ in. for comfortable one-hand operation, according to maker, with greatly reduced torque reaction.

The ⅜-in. wrench is the forerunner of a completely new line of *Thor* impact tools, which will also be available soon in capacities of ¼, ⅝, ¾ and 1¼ in. **Dept P, Independent Pneumatic Tool Co, Chicago, Ill.**

Plaster-Wall Seal

PLASTER GRIP, a dual-purpose liquid, for priming and sealing plaster walls in one quick operation, can be applied when walls are still wet and, according to maker, because of its high alkali resistance there is no danger of discoloration from "lime-burns"

Tough.. Lively ...COOL-RUNNING

War-time Shortage Produced a BETTER RUBBER for TEXROPE V-BELTS

LACK of natural rubber forced the development of synthetic rubbers. And out of this intensive war-time research came a rubber compound that has made today's TEXROPE "Super-7" V-Belts the BEST in 20 years of V-Belt experience!

This war-proved Buna-S develops 75% less internal heat. It's tough, durable, resilient. It cushions, insulates and protects the load-carrying cord structure — adds to the service life of the belt.

HEADQUARTERS FOR V-BELT DRIVES

Your nearest Allis-Chalmers office or dealer offers a COMPLETE line of V-Belt equipment — not only the famous Super-7 belts, but also TEXSTEEL, TEXDRIVE and "MAGIC-GRIP" sheaves, VARI-PITCH sheaves, SPEED CHANGERS, engineering service. Supply *all* your needs from one reliable source. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 2086

5 Super-7 V-Belts ... TO MEET EVERY NEED

Heat-Resisting Super-7
Stands temperatures up to 180°. The TEXROPE V-Belt for most drives.

Oil-Resisting Super-7
Neoprene cover protects core against moderately oily or greasy conditions.

Oil-Proof Super-7
Made of Neoprene throughout. Use it when the belt must swim in oil.

Static-Resisting Super-7
Recommended where explosion hazard exists. Static-conducting element throughout cover won't wear off.

Super-7 Steel
Twin steel cables, to pull extremely heavy loads with minimum stretch.

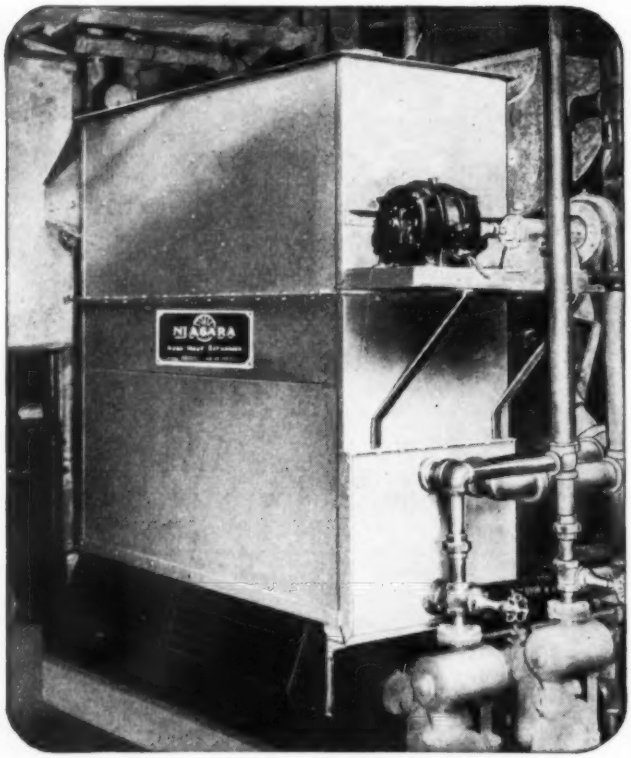
GET THEM — through your Allis-Chalmers district office or dealer.

TEXROPE Super-7 V-Belts result from the co-operative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

TEXROPE V-BELT DRIVES



Trustworthy Water Jacket Cooling for Industrial Power Equipment

Ample cooling capacity, with freedom from the maintenance troubles of open-system water cooling, supports higher production.

The NIAGARA AERO HEAT EXCHANGER provides a closed system of re-circulated, clean jacket water at a controlled temperature. Operating your diesel or gas engines or other machinery at the correct temperature assures you of full-rated power, and freedom from frequent shut-down and mechanical trouble.

Using the NIAGARA AERO HEAT EXCHANGER also provides operating economies that quickly pay for the equipment. The heat is removed by air and the high cost of cooling water is eliminated.

Write for Bulletin 96 for complete information.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

DEPT. P-76 6 E. 45th St. NEW YORK 17, N.Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

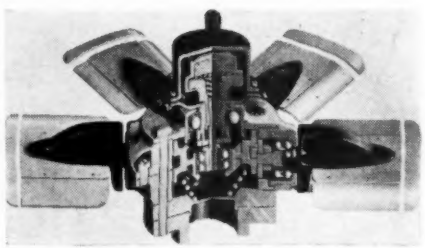
HUMIDIFYING • AIR ENGINEERING EQUIPMENT

and no flashing. Plaster walls covered with only one coat of *Plaster Grip* are claimed to be sealed so effectively that a single coat of gloss paint applied over this priming holds its luster and color. *Plaster Grip* has no objectionable odor, can be used over old paint, and is quick drying. One gal covers about 800 to 1000 sq ft of new plaster. **Dept P, Gillespie Varnish Co, Dey & Howell St, Jersey City, N. J.**

Couplings

SERIES A COUPLING has been designed for a much larger maximum bore to permit use of smaller-sized couplings than would ordinarily be required. It retains all exclusive construction refinements that have been basic in Waldron couplings: all steel, made to close manufacturing tolerances, dustproof, oil tight, identical externally geared hubs that key to shafts, inclosed by one-piece male and female sleeves that function as a single rigid unit. *Series A* coupling compensates for misalignment without adding stress to shaft or bearings.

Coupling is made in standard, heavy duty, marine, mill motor, floating shaft, jordan, shear pin, oil collector and cut-out styles. **Dept P, Coupling Div, John Waldron Corp, New Brunswick, N. J.**



Variable-Pitch Fan

FRONT-OPERATING ADAPTER DESIGN of thermal power element in Evans *Thermo-Control* fan has been released. This new model has been engineered to simplify installation of the Thermo-Control fan in existing engine mounts when necessary clearances are available. To install the new model, remove old fan from fan hub and remount *Thermo-Control* fan with correct mounting flange to fit hub.

Fan is variable-pitch self-adjusting design operated by a built-in thermal power element. Adjusting itself to changes in engine and ambient temperature, fan maintains near constant engine-operating temperature, increasing hp output, nearly all formation of sludge deposits in engine and lubricating oil. Fan is made in 4-, 6- and 8-blade models. **Dept P, Thermo-Aire Div, Evans Products Co, 15310 Fullerton Ave, Detroit 27, Mich.**

Gun-Loading System

GUN-LOADER FITTING, mounted on head of hand gun, permits grease to flow into grease reservoir of gun in same manner that it flows into a bearing through a lubrication fitting in normal lubrication. A loader valve mounted on a bucket pump or loader pump, functioning like a coupler

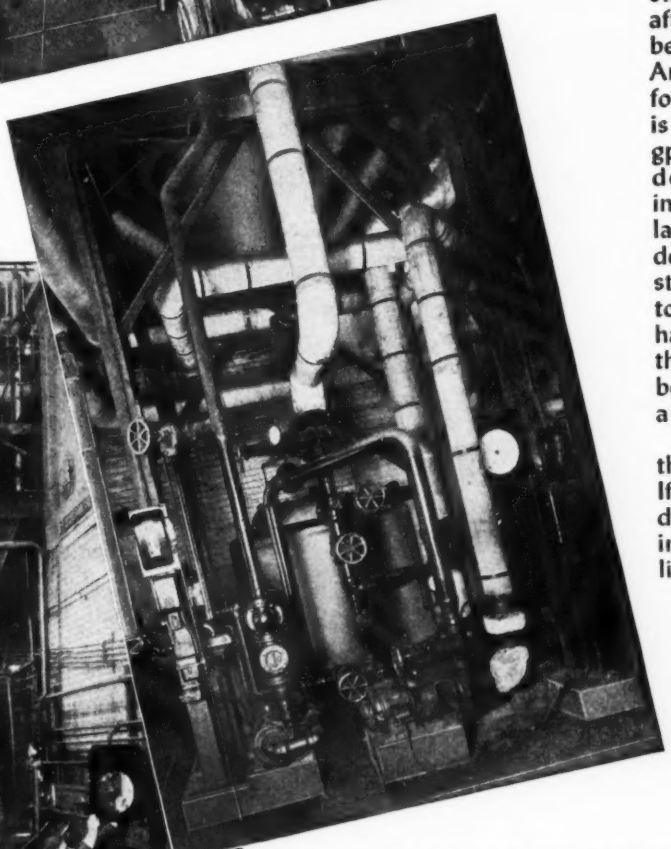
COCHRANE

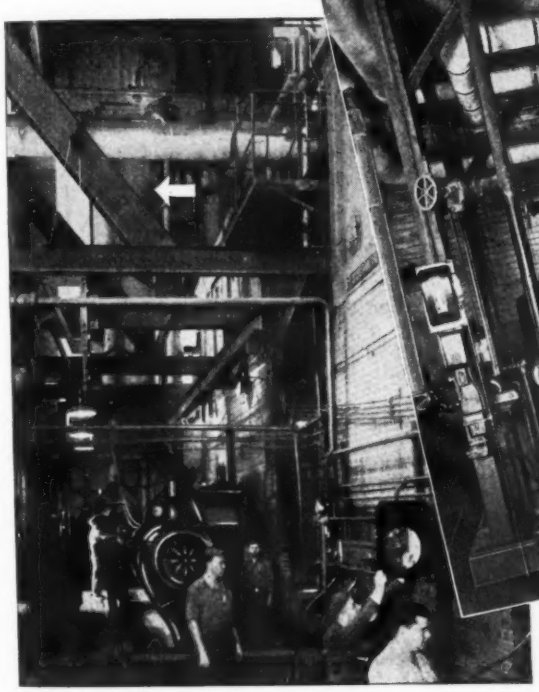
HOT PROCESS SOFTENER

(Above) Showing Sedimentation Tank and Filter in rear; Chemical Proportioning Pump in foreground.

(Lower Right) View of Filter with Sedimentation Tank above.

(Below) Boiler Aisle showing Softener in background.





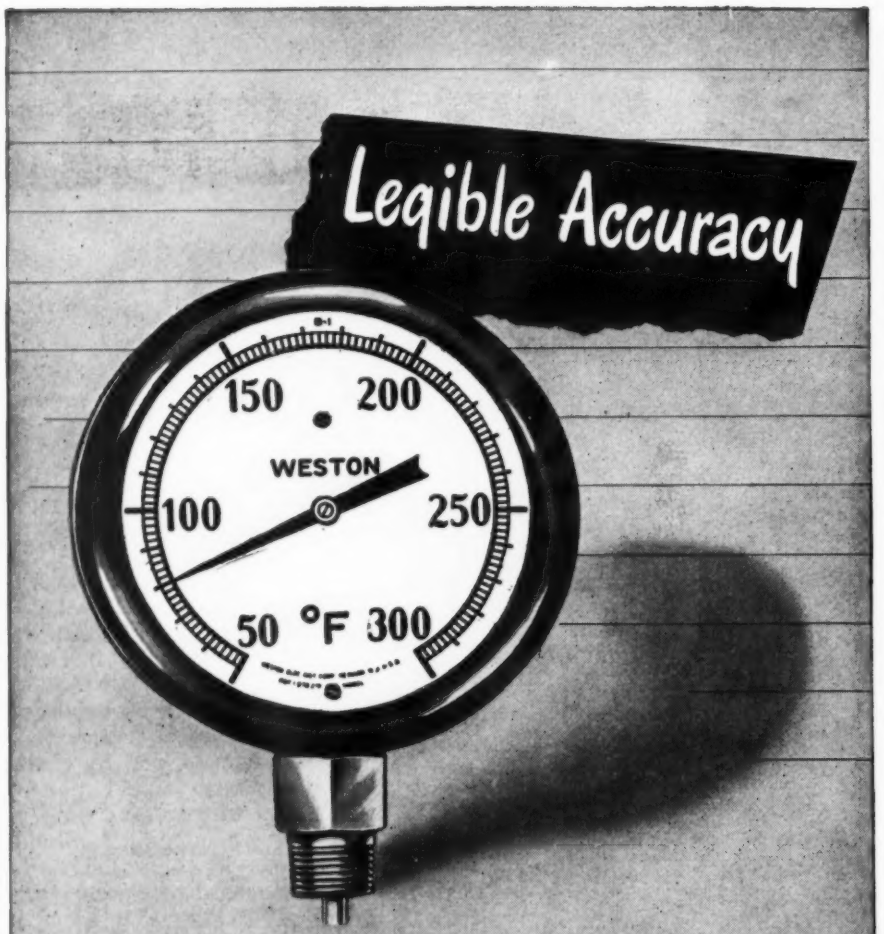
at Cramp's

THE Cramp Shipbuilding Company, or Cramp's Shipyard, as it is known to all Philadelphians, had more to do with the building of America's maritime and naval strength up to the middle thirties than probably any other yard in the country. Then with little marine activity it was shut down for 13 years, but at the start of World War II it went back into service. The Cramp Shipbuilding Company since then has turned in a fine record of performance, and is still going strong.

In the boiler room, the 30-year old boilers, put back into service after their 13-year lay-off, are being operated at 250% of rating. Among the factors given credit for their excellent performance is a Cochrane 12,000 gph (5,000 gph raw water, 7,000 gph condensate) Hot Process Softener installed in 1941. Since its installation, though the boilers have delivered 1,500,000,000 lbs. of steam, it has not been necessary to turbine the boiler tubes, there have been no tube failures and the only attention necessary has been to wash the boilers out with a hose once a year.

Such performance is typical of the Cochrane Hot Process Softener. If you are interested in water conditioning of boiler feed or other industrial water supply, write for literature or other data.

COCHRANE CORPORATION • 3106 North 17th Street
PHILADELPHIA 32, PA.



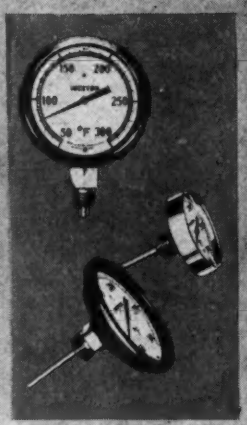
WESTONS...

are easy to read accurately even in difficult locations

Not only are WESTON thermometers *inherently* accurate over the entire scale, but their gauge-type dials with bold figures and divisions can be *read* easily . . . without error or guesswork . . . even in dim light or when mounted in difficult-to-get-at locations.

Their all-metal construction, too, enables them to *maintain* their dependable accuracy over long periods, despite vibration or subjection to temporary over temperatures. There are no vital parts to break or leak, nothing under pressure.

WESTON thermometers are available in types, sizes and stem lengths for equipment mounting, as well as for all industrial and processing requirements. Ask for Bulletin.

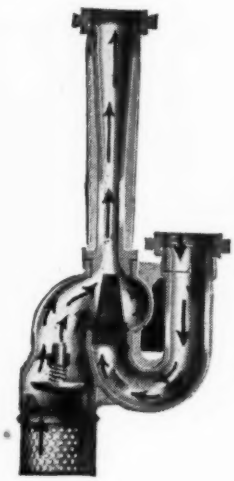


Weston *All Metal* THERMOMETERS

Weston Electrical Instrument Corporation, 679 Frelinghuysen Ave., Newark 5, N. J.

when applied to a fitting, is the companion item to the loader fitting on the hand gun.

While several hand guns, both push and lever designs, as well as loader pumps of 25-, 35-, 100- and 400-lb capacity, all equipped with special fittings and facilities required by new gun-loading system, are announced as ready, users of guns and bucket pumps already in field can convert their equipment to new system. Loader valve No. G-306740 may be installed in either lever or push guns simply by drilling and tapping ⅛-in. pipe thread. A loader kit, No. G-306910, containing all necessary parts to convert any bucket pump into a loader, and including one loader fitting for a hand gun, is also available. A bracket to hold gun on side of bucket is also included in this kit. **Dept P, Alemite Div, Stewart-Warner Corp, 1826 Diversey Parkway, Chicago, Ill.**

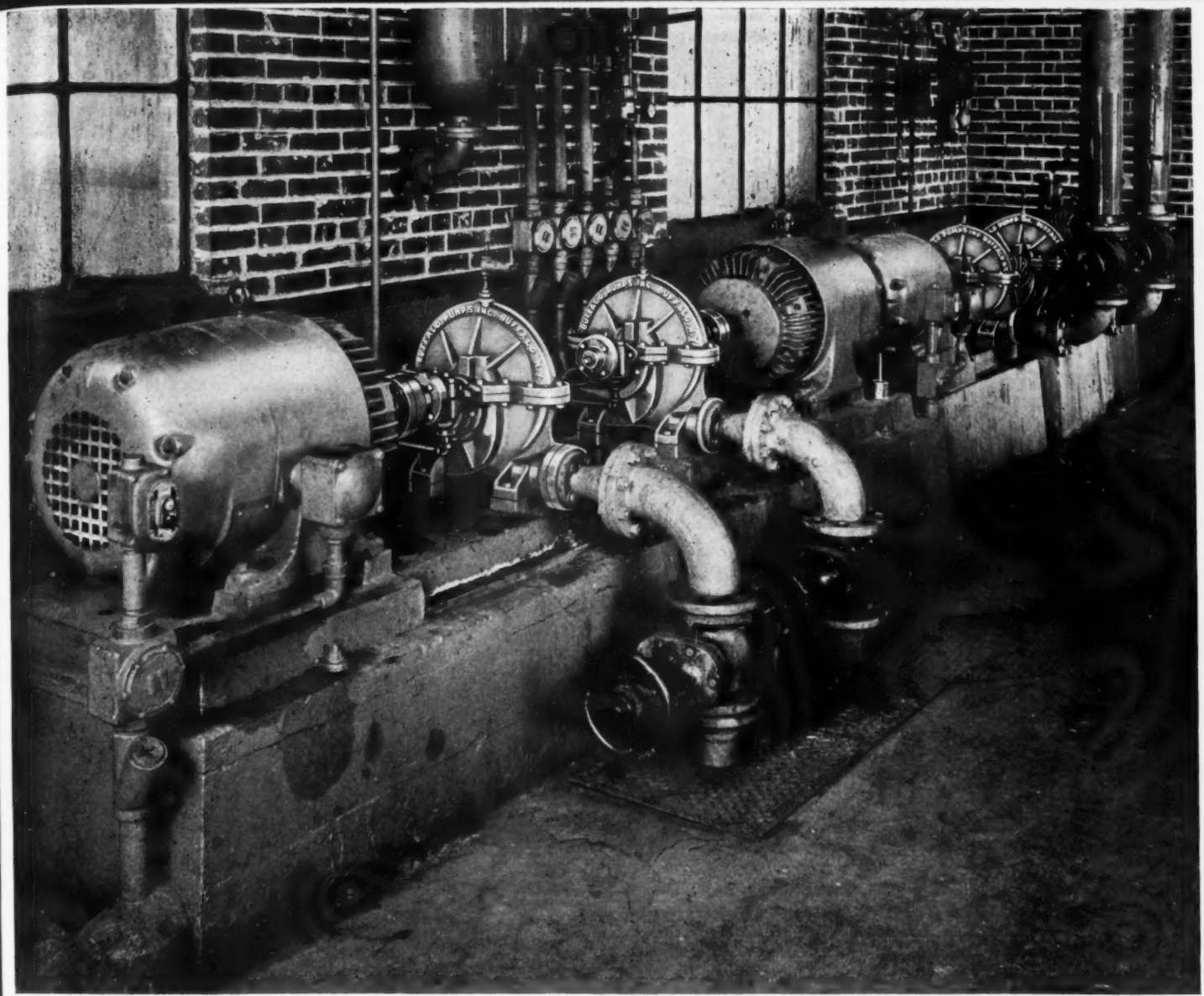


Pump Booster

ACCEL-O-RATE PUMP booster makes available water supplies for fire fighting and permits water drainage from pits or cellars beyond reach of standard pumping equipment. Using standard fire-pumping equipment or its equivalent, pump booster lifts water vertically 100 ft or more and drafts water for distances of 200 to 300 ft from water sources impossible to reach because of gulleys, ditches, mud or other obstacles. Employing the jet-pump principle, this unit has no moving parts, weighs but 18 lb, and will not become clogged. **Dept P, Jet Pump Div, Derbyshire Machine & Tool Co, 5218-W Belfield Ave, Philadelphia 44, Pa.**

Gasket Seat Grinders

ELLIOTT MANUFACTURES electric-driven as well as air-driven handhole seat grinders. The drives are interchangeable. These grinders provide an easy, fast and accurate way of refacing handholes of all sizes and shapes through a grinding wheel properly aligned with gasket seat by four screws in an adjusting plate. The electric-driven machine incorporates a special high-speed 110-v universal motor which has a trigger handle mounted on it. Switch can be locked in the "on" position and released by a quick pull of trigger. In the air-driven model, Elliott standard 600 series tube-cleaner op-



Compact, Husky and Efficient

Buffalo Pumps are giving excellent service in many plants handling a variety of acids and alkalis, as well as clear water. They are efficient, they are compact (a convenience in many piping layouts), and they're husky enough to give continuous service for long periods.

Adequate range of sizes makes selection of the right capacity easy.

Write for Bulletin 955.

BUFFALO PUMPS, INC.

488 BROADWAY **BUFFALO, N. Y.**

CANADA PUMPS, LTD., KITCHENER, ONT.

"Buffalo"

CLASS "SL"

PUMPS

For the Man Who MUST Know About PUMPS

If it is your job to see to it that the right pump is used for the pumping problem at hand, be sure you have the latest information on Viking Rotary Pumps.

These pumps are self priming; capable of delivering against discharge pressures up to 200 pounds per square inch; smooth, even flow with no pulsation; operate at slow speed for long, dependable life; only two moving "gear within a gear" parts assure low cost operation and service.

If your problem is pumping fuel oil, lube oil, water, etc., send for free bulletin 46SW today. It will help you in making the right selection.

See Our Catalog In SWEETS

VIKING PUMP COMPANY
CEDAR FALLS, IOWA

only 1 Man required to operate

SAUERMAN SCRAPER SYSTEM for COAL HANDLING

Picture shows a small Sauerman scraper handling an 8,000-Ton stockpile in crowded space between mill buildings. Quite a contrast to the big Sauerman units, but just as important in its way.

A one-man operation that solves your problem of storing more coal with less labor.

You can store and reclaim your coal, and utilize to the best advantage all available space, more efficiently and more economically with a Sauerman Scraper System. Piles compactly and safely—with no segregation of lumps and fines. Minimizes dust and dirt. Adjustable range with suitable equipment for large or small consumers. Initial cost is small—operating cost extremely low.

Sauerman Systems have proven profitable, trouble-free investments for hundreds of plants. Your own inquiry will be welcomed.

Write for catalog.

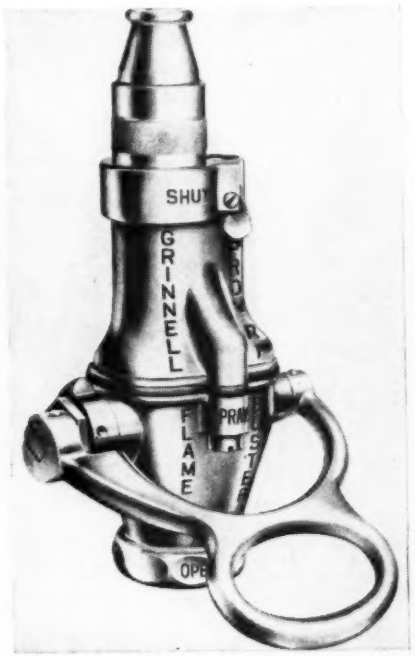
SAUERMAN BROS., Inc.
562 S. CLINTON ST., CHICAGO 7, ILLINOIS

erates with compressed air at 80 to 100 psi.

Complete outfit for this grinder includes one coarse grinding wheel, one fine grinding wheel, and one guide roller for width of seat specified; also, a cup wire brush, stud adapter, viewing mirror, wrenches, and for air-driven machine, air hose and sight-feed lubricator. **Dept P, Lagonda Div, Elliott Co, Springfield, O.**

Enamel Finish

PORCIFLEX BAKING ENAMEL is said to be unusually durable and fast drying. Finish has high resistance to acids, alkalis, oils and greases. Applied by spray, roller coating, machine or dip, *Porciflex* is baked at schedules from one min. at 450 deg for sheet steel to 15 min. at 275 deg for other work. It is well adapted for infrared baking. It is available in clear, black, white and all colors. Maker states it will neither crack and flake when struck nor peel off under normal conditions. **Dept P, H V Walker Co, Elizabeth, N. J.**



Hose Nozzle

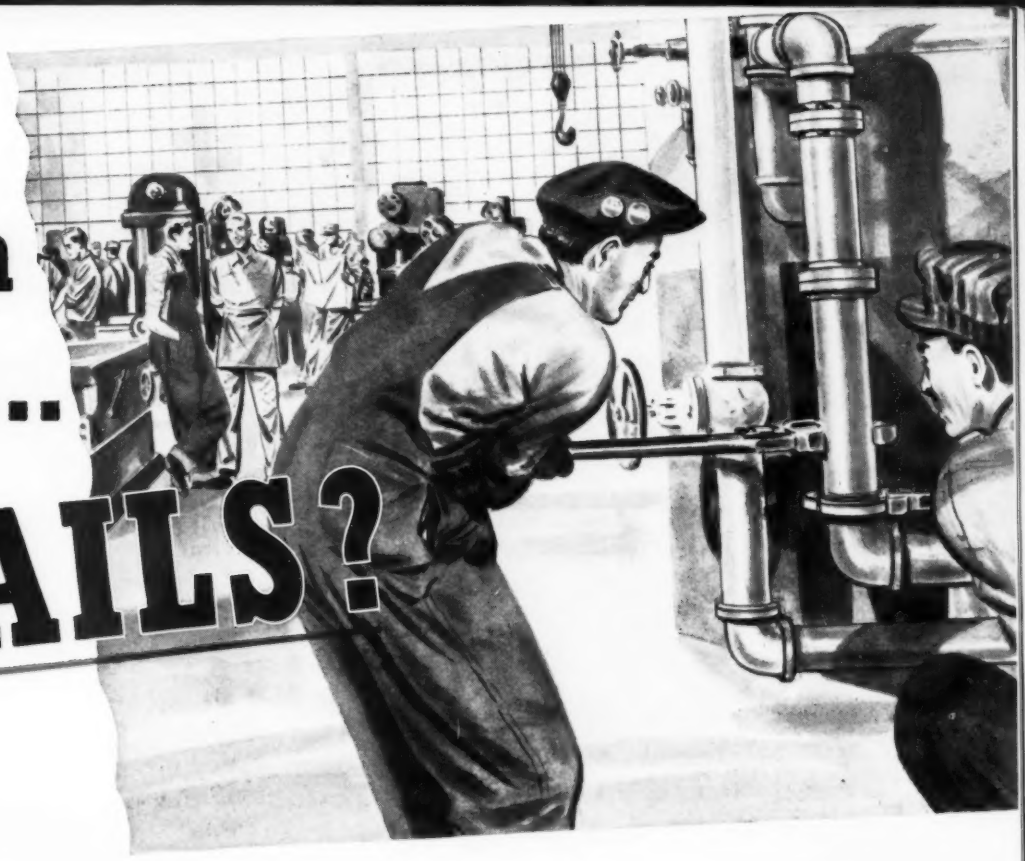
FLAMEBUSTER, a 3-purpose, portable, bronze hose nozzle, disperses water in correct droplet sizes and drives at correct velocities to to put out oil fires by forming water-carrying emulsions at burning-oil surface. It is primarily for use with water, but equally successful with foam or chemicals to be applied as a high- or low-velocity spray and as a solid stream.

A 4- to 10-ft applicator and low-velocity spray tip, which is interchangeable with the high-velocity spray tip, adapts *FlameBuster* for application of fine droplet spray at low velocities required for extinguishing fires in the lighter oils and kerosene using water alone. Operator at all times has a choice of two forms of water, solid stream and high-velocity spray, or solid stream and low-velocity spray.

Water passages through body of *Flame-*

(*Continued on page* 172)

What Does a Fitting Cost... IF IT FAILS?



Lost Production Time, Expensive Repairs Minimized by LADISH

FORGED STEEL FITTINGS

The *greatest* cost of a fitting is the loss in production time that results when it fails. That is why it is sound economics to install Ladish Forged Steel Fittings. Their increased dynamic strength and ability to withstand repeated shocks, strains and stresses are a direct result of advanced forging methods and superior metallurgical controls.

Ladish controlled quality Forged Steel Fittings are your assurance of economical trouble-free operation . . . and higher profits!

Write for your Ladish Forged Steel Fittings Catalog, Vol. II.

Controlled Quality

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN (MILWAUKEE SUBURB)

District Offices: NEW YORK • BUFFALO • PITTSBURGH • CLEVELAND • CHICAGO • ST. LOUIS • HOUSTON • NEW ORLEANS • LOS ANGELES

TO MARK PROGRESS

INFILCO

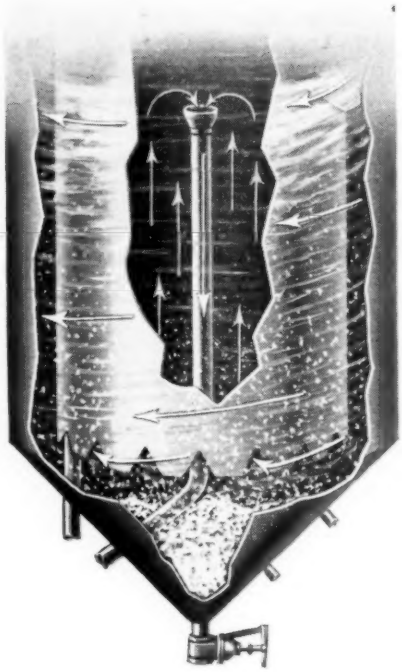
Better sedimentation produces Uniform Boiler feed water

One unit solved *three* worries at this plant . . .

Raw water at this southern refinery is the troublesome type. Not *properly* treated, it could cause hard, glassy scale, sludge and foaming. Reasons for this not-too-happy outlook are silica, hardness and high alkalinity. So in installing treating equipment, guesswork wouldn't do. These were questions for considered answers . . . from INFILCO engineers.

In this case, as in many others, proper treatment centered around *effective* reactions with selected chemicals in the sedimentation tank. Dissolved silica, hardness and alkalinity had to be reduced to harmless amounts. These objectives were established by careful analysis of the raw water, and here are the results.

Thorough mixing of heated raw water and chemicals begins in the mixing compartment of the INFILCO Sedimentation Tank. From this turbulent zone, the water flows in a quiet spiral that allows time for *complete* chemical reaction. Reaching the bottom of the tank, it flows upward, fully treated, to the settled water take-off. That sequence continues its day-in, day-out job of removing the trouble-causing elements from the water at this plant. It's one of the examples of reliable analysis and dependable performance that characterizes Hot-Flow installations the country-over. INFILCO INC., 325 West 25th Place, Chicago 16, Illinois.



It's the *internal* design that produces *better* chemical mixing, *better* solids separation and *better* sedimentation in the Hot-Flow Tank.

Unique in construction, the interior is divided into three sections. An upper section is the mixing zone. This is divided, by a stilling plate, from an outer annular compartment, which is equal in volume with a central cylindrical uptake.

Thorough mixing of chemicals and thorough sedimentation in this tank always insure an adequate volume of properly treated feed water ahead of the filters.

CONSULT INFILCO — FIRST IN WATER AND TRADE WASTE TREATMENT

"ABSOLUTE Absence of Sludge ..."

since using Tycol turbine oils"

"Repair bills slashed 30% . . . Ten years without an oil change . . . Bearings show no signs of wear . . . Oil consumption cut in half . . ."

These results are typical of the unusual performance achieved with Tycol Turbine Oils. Refined by a special process, these modern lubricants stand up under the toughest service conditions . . . retain their original characteristics.

Call your nearest Tide Water Associated Office today for full information about the time- and money-saving advantages of Tycol Turbine Oils. Rust inhibited *Tycol RIO Turbine Oils* are also available for operations where corrosion is a factor.

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
Pittsburgh • Philadelphia

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

U.S. INSTRUMENTS Tell The Truth

USG

PRESSURE, TEMPERATURE, FLOW, ELECTRICAL AND LEVEL MEASURING INSTRUMENTS

UNITED STATES GAUGE

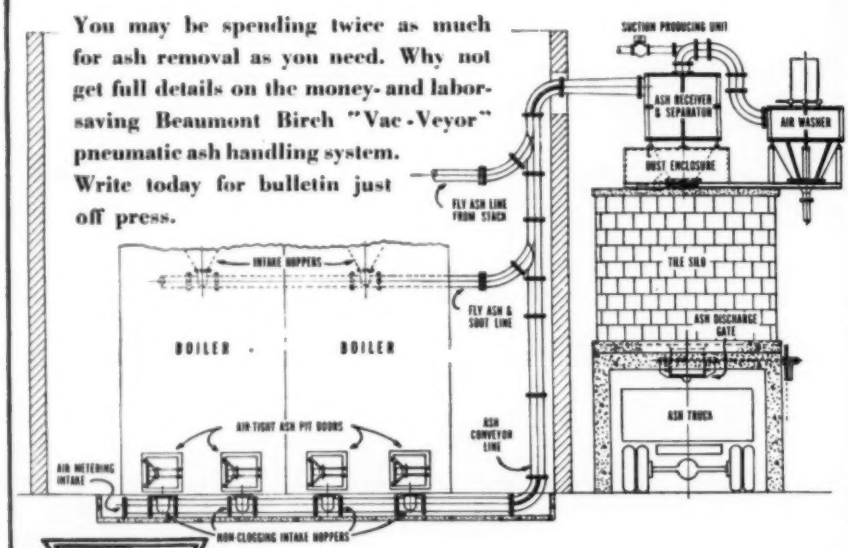
6 out of 10 manufacturers of original equipment specify U.S.G.

DIVISION OF AMERICAN MACHINE AND METALS, INC.

SELLERSVILLE, PENNSYLVANIA (15)

HOW MUCH ARE YOU PAYING TO HANDLE ASHES?

You may be spending twice as much for ash removal as you need. Why not get full details on the money- and labor-saving Beaumont Birch "Vac-Veyor" pneumatic ash handling system. Write today for bulletin just off press.



BEAUMONT BIRCH COMPANY

1502 RACE STREET PHILADELPHIA 2, PA.

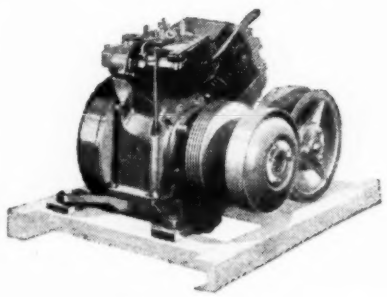
DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

Buster are unrestricted and substantially straightaway, assuring low-friction loss. Mechanical construction is rugged and designed to provide easy operation at all working pressures.

While incorporating means of producing the required droplet sizes and velocities to put out oil fires, *FlameBuster* is successful in quick extinguishment of fires in wood, paper, trash and similar materials. **Dept P, Grinnell Co, 260 W Exchange St, Providence 1, R. I.**

Shower Valve

SAFETYMIX CONCEALED TYPE C shower valve prevents sudden scalds through its instantaneous response to changes in water pressure. Valve maintains selected temperature, according to manufacturer, within two deg against pressure fluctuations. *Safetymix*, with only two moving parts and positive water-pressure operation, eliminates complicated thermostatic devices, bimetal coils, bellows, springs and check valves. Its self-cleaning action eliminates clogging. All parts are accessible from the front. Valve seats are renewable. *Safetymix* is said to be as easy to fix as a faucet. **Dept P, Symmons Engrg Co, 791 Tremont St, Boston.**



Automatic Transmission

SALSBURY POWER PACKAGE consists of a variable-diameter driving pulley, a variable-diameter driven pulley and a V-belt. These units form a coordinated assembly that gives automatic, infinitely variable ratios over a 4 to 1 range. It is a completely automatic driving unit in which drive ratios are controlled by driven unit, and clutch engagement is controlled by engine speed.

It is a true torque converter. Drive ratio is controlled as a function of driven shaft speed. Normal over-all reductions may range from 4-1 to 1-1 for light-duty high-speed units, and from 200-1 to 50-1 for heavy-duty low-speed requirements. Automatic change of ratio within these limits may be adjusted to suit needs. Transmission may be originally assembled to limit engine speed automatically to any desired value under normal operating conditions.

Built into the driving pulley is the Salsbury clutch, an automatic, centrifugally operated opposed-shoe design, which is said to provide smooth engagement and disengagement with acceleration or deceleration of engine.

Engine is Salsbury Model 600. It is a single-cylinder 4-cycle air-cooled design, developing 6.5 hp at 3200 rpm, or one-third hp per cu in. of displacement. **Dept P, Salsbury Motors, Inc, 4464 District Blvd, Los Angeles, Calif.**

KNOWN SINCE 1893 FOR QUALITY AND DEPENDABLE DELIVERY

shaw

DEPENDABLE PIPING

PRE-FABRICATION and INSTALLATION

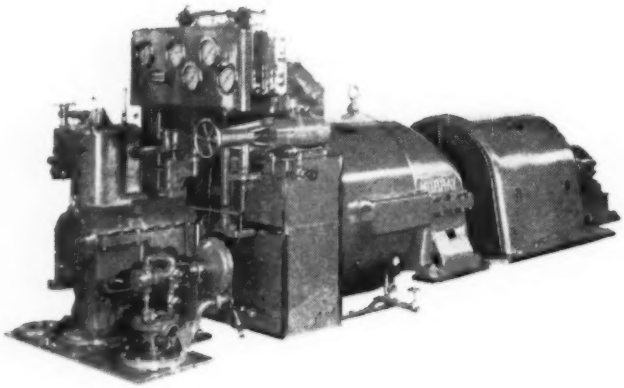
Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping—any place in the United States and Canada.

Benj. F. Shaw II

President

Benjamin F. Shaw Company, 2nd & Lombard Sts., Wilmington 99, Del.

MURRAY
STEAM TURBINE GENERATING UNITS



Installed in 1939 in a small municipal power plant in northeastern Indiana, the above 500 KW direct connected Murray steam turbine generator set has given its owner entire satisfaction. The turbine is equipped with every device necessary for minimum of attention including steam turbine driven auxiliary oil pump. The generator and exciter may be furnished to match existing electrical equipment in your plant.

Units in this size may be furnished either direct connected or geared as preferred with performance and operation equally trouble-free.

There is a Murray representative ready to help you with design and layout information.

MURRAY *also produces*

Mechanical Drive Turbines — Horizontal and Vertical Reduction Gears of the high speed type Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

Power News

(*Continued from page* 138)

day morning, May 17, leaders of the aviation and marine fields urged as necessary a ten-million-dollar "meteorological fleet" of ships in the North Atlantic to aid aviation weather reporting, and a peacetime merchant marine of 15 to 20 million deadweight tons. Dr Edward Warner, president of Interim Council of Provisional International Civil Aviation Organization, and Vice Admiral Emory S Land, wartime head of the U. S. Maritime Commission, outlined today's pressing needs in their respective fields. On the same symposium, which dealt with the subject of transportation, Martin W Clement, president of the Pennsylvania Railroad, asserted that to keep America strong not only in the transportation field but in all fields of endeavor, the American people must impose self-discipline. The alternative, he said, is government-imposed discipline and then "we will all have lost our liberty."

Also speaking at the same symposium was Harland Bartholomew, prominent civil engineer responsible for various phases of layout in 50 American and Canadian cities, who discussed "Transportation Planning in Urban Areas."

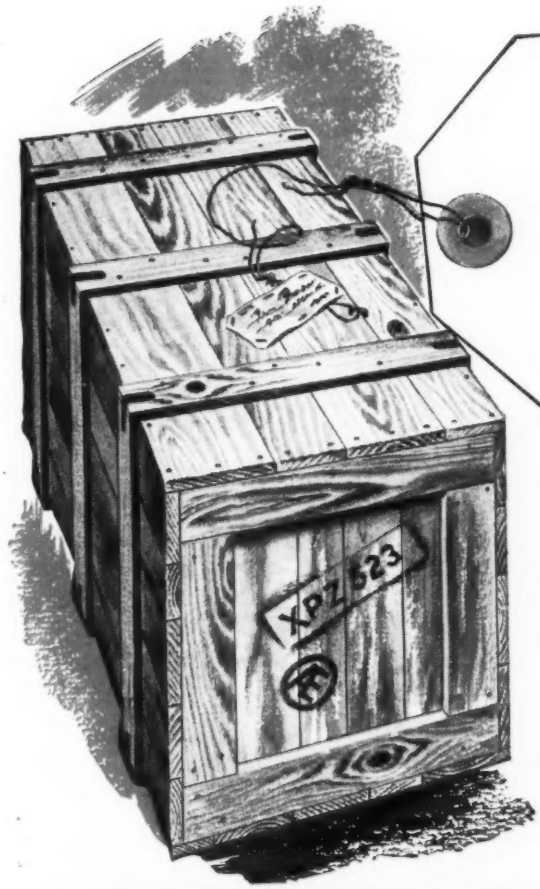
FRANK B. JEWETT

Speaking before the noon luncheon on Friday, May 17, Frank B Jewett, president of the National Academy of Sciences, declared: "Radio broadcasting has become a powerful implement in the social and political life of the nation and the world—so powerful in fact that great danger to society might easily result were it to become the tool of political government. Because of the way in which we here in America have developed radio, it is a unique industry in that the ultimate consumer pays virtually no part of the cost of the service he receives.

Dr Jewett, who also is vice-president in charge of research and development for American Telegraph and Telephone Co, asserted that he sees no basically new communication systems arising from wartime discoveries and developments.

At the symposium, "Biological Science," on Friday afternoon, May 17, Dr George W Beadle, professor of biology at Stanford University, declared that music ability is hereditary. He told the delegates that environment also plays a part in such matters.

Dr. Selman A Waksman, the university professor who discovered the "wonder drug," streptomycin, predicted that "the time is not far off" when such diseases as



CONTENTS— ONE STOKER THAT WON'T CLOG!

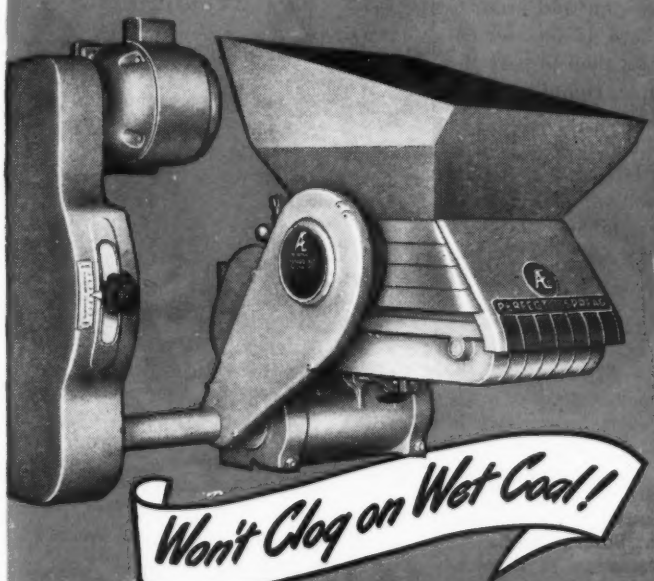
IT'S A FACT! The Æ Perfect Spread Stoker hasn't clogged yet. Even when your coal supply is wet or partially frozen, it feeds readily, *steadily*, through a foolproof mechanism to the reliable *overthrow* rotor that spreads a "perfect" fuel bed. Your fuel firing is *safe*guarded by the exclusive Æ non-clog feature, your steam costs reduced because you get more steam from the very lowest grades of coal and solid fuels.

Designed simplicity from hopper to grates and fully automatic operation from a *single* low cost power source brings you greater combustion efficiency and new freedom from fuel worries and maintenance problems. Send for the Æ Perfect Spread Stoker booklet and look into all the advantages to be gained by modernizing your boiler room *now—with the only non-clogging stoker of its kind!*

Æ

PERFECT SPREAD STOKER

WITH STATIONARY GRATES, DUMPING GRATES OR CONTINUOUS ASH DISCHARGE—UP TO 400,000 LBS. OF STEAM PER HR.



Won't Clog on Wet Coal!

IT'S SEASONED IN *EXPERIENCE*

NEW IN PERFORMANCE!

The Perfect Spread Stoker has a record of proved economy—in 15 types of industries—over a 17 year period!

Other Æ Products: Æ-Taylor Stokers, Lo-Hed Hoists, Marine Deck Auxiliaries, Hole-Shaw Field Power.

AMERICAN ENGINEERING COMPANY

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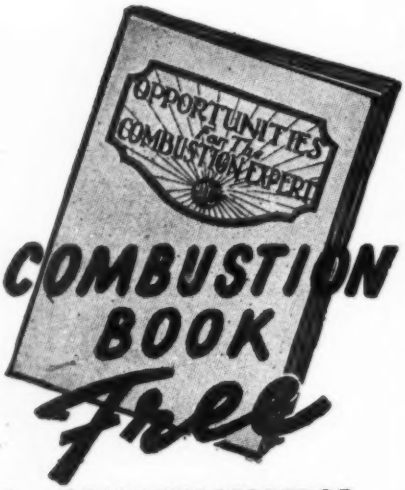

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the common cold, infantile paralysis and tuberculosis "will be brought under practical control" through enlargement of medical knowledge and development of new drugs. "Within a period of only five years," said Dr Waksman, "we have witnessed the development of radically new methods of treating a variety of diseases in man and in animals. The possibilities are just being explored and there is promise of greater things in the future, notably in finding agents to combat a great variety of diseases, especially the viruses, against most of which no effective agents are known at present."

At the Friday evening session, May 17, A W Robertson, chairman of board of Westinghouse Electric Corp, remarked that gifted scientists should study human beings next. Speaking on "The Golden Age of the Future," he declared that "we need in the next golden age to learn something about ourselves so that we may make better use of the marvels which gifted men have provided for us.

"Man has devoted his genius wherever it has appeared to improving his environment and not himself," he said. "The confusion in our national and international thinking points definitely to the conclusion that we have no rules to guide us in the matter of human relations. As human beings, we do not know how we should behave," he continued.

Dr Karl T Compton, president of Massachusetts Institute of Technology, declared on the subject, "Scientific Progress—Insurance Against Aggression and Depression," at a dinner meeting on Friday evening, May 17, that "both for security against aggression and security against depression there is no element which is more important than to have the most adequate possible complement of able, well-trained scientific personnel in our country. This is more important in the last analysis than laboratories or factories, he said, "because without scientists of the highest caliber, laboratories will only be a delusion and a waste of money, and factories will become obsolete.

Recent formation of Brown Boveri Corp, a New York corporation affiliated with Brown Boveri & Co, Ltd, of Baden, Switzerland, is announced by Paul R Sidler, president of the new corporation. It will carry on, in expanded form, the activities of Mr Sidler, for the past 15 years resident engineer in New York for Brown Boveri. Plans include intensified dissemination of information on Brown Boveri equipment—steam turbine generators, gas-turbine power plants, turbochargers, Velox boilers, blast-furnace turboblowers, oil circuit breakers, rocking-contact voltage regulators, mercury-arc rectifiers, high-speed air-blast breakers, control equipment and protective relays—and organization for prompt and dependable service.

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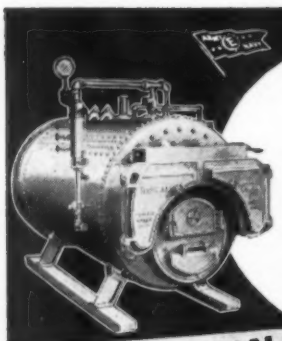

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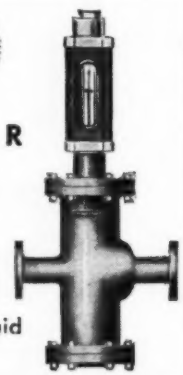

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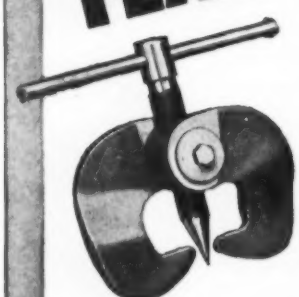

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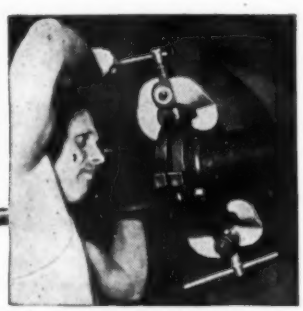

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Prof Adams Discusses Future Fuel Supply

Coal may be burned in the mine, instead of being removed, to produce power in the future, Prof Roger Adams, head of chemistry dept in University of Illinois and chairman of board of directors of American Chemical Society, remarked recently in the first Remsen Memorial Lecture, sponsored by the society's Maryland section. The lectureship was established this year in honor of Ira Remsen, pioneer in American organic chemistry, who was born 100 years ago. Dr Remsen, who was president of the American Chemical Society in 1902, was the first professor of chemistry and second president of Johns Hopkins University.

"Just as sulphur is melted in the ground and pumped out in liquid form, it is not too fantastic to believe that with cheap oxygen, such as has been discovered in the Soviet Union, coal may be burned in the mine," asserted Prof Adams, whose topic was "Chemical Research in the War and Post-war Periods."

"The heat generated in the gases and the subsequent burning of the carbon monoxide would provide the power for a utility plant nearby," he explained. "The carbon monoxide might also be reduced to petroleum."

Need for research on new ways of augmenting America's fuel supply was stressed by Prof Adams, who recently returned from Europe after serving as special advisor to Lt Gen Lucius D Clay, deputy military governor, American occupation zone, Germany.

SYNTHETIC FUELS

"The liberal supply of petroleum in this country has led to the relative neglect of the study of synthetic fuels from coal or from carbon monoxide, problems which were of highest priority in German research," Prof Adams pointed out. "The U. S. still has a large reserve of petroleum, but by no means an inexhaustible one. The importation of petroleum to maintain our reserves will probably continue as a future policy, but an intensive effort should soon be initiated to discover other methods of implementing our fuel supply. The catalytic oxidation of natural gas to carbon monoxide and hydrogen represents a paper reaction which may be fulfilled in the laboratory. From these products conversion to petroleum could follow by established procedures."

Prof Adams said that byproduct results were as significant as direct results of American wartime scientific investigations.

"The new and convenient syntheses of aromatic hydrocarbons from petroleum, of high anti-knock gasoline and of synthetic rubber represent important processes for the future industrial world. A synthetic rubber comparable in price and quality with natural rubber may be expected as a result of further researches based on the war experiences.

"The potentialities of acetylene as a raw material in the chemical industry were revealed by the Germans, and it may be anticipated that in this country more and more research will eventually result in useful materials as yet unknown from this source.

"Nuclear energy for special power purposes may appear sooner than many have predicted."

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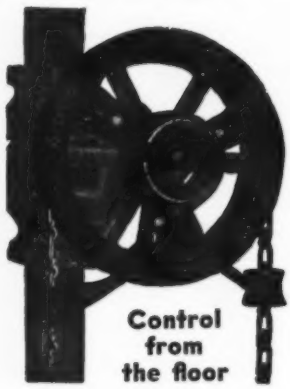

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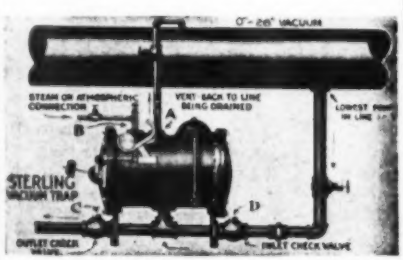

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USSR Plan Includes New Hydro Power Plants

Moscow (*McGraw-Hill World News*): Completion of 41 new power stations and partial construction of 36 more are the goals of the Soviet Union's fourth 5-year plan for the electric power industry. Work on rehabilitation and construction of hydroelectric power plants is being pushed under this plan (POWER, Jan, 1946, pp 76 and 77). Emphasis will be placed on utilization of water power rather than steam in the new development program.

In addition, 70 stations, now under construction, are to be completed by 1948, according to the commissar of electric stations. In the over-all picture, new construction and restoration work has a potential capacity of 2,000,000 kw. Major restoration projects are at the Dnieper, Volkhov and Svir River plants. The dam at the Dnieper project has been repaired and installation workers have been assigned the task of having the first generators in operation before the end of the year. On the Kola peninsula rebuilding includes expansion to provide power for development of Pechenga and Monchegorsk nickel fields.

Construction of Gyumush hydro station on Zanga River gorge is getting under way. The third and largest link in the so-called Sevan-Ganga cascade, it will triple the power available to Armenian industry when completed. The first unit, with a capacity of 53,500 kw, is scheduled for completion in 1950.

KARELIAN-FINNISH REPUBLIC

In the Karelian-Finnish Republic power stations with a total capacity of 81,000 kw, including hydro units with a capacity of 45,000 kw, are to be built. In addition, construction of collective farm hydro stations by the farmers themselves is being promoted and by the end of this year 60 are expected to be in operation.

Development under the 5-year plan of hydroelectric plants at Gorki, Kaluga and Nizhni-Vyatsk will save 2,000,000 tons of peat and long-haul coal in the central part of European Russia. Other stations in the 5-year program include Mingechuar on the Kura River to supply industries in the Baku area with 1,400,000,000 kwhr annually, Kremenchug on the Dnieper and several plants around Lake Sevan.

In Asiatic Russia, it is planned to augment war-built stations at Tashkent with stations at Farkhad and Kzyl-Orda along the Syr Darya River, at Ust-Kamenogorsk on Irtysh River near the border of western China (power will be used primarily for smelting non-ferrous metals of Altai Mountain region), at Kamen on the Ob River near Novo-Sibirsk, at Molotov Oblast on the Kama River and at Irkutsk on the Angara River. Only the first units of the Angarastroi at Irkutsk will be completed by 1950, but will provide about 800,000,000 kwhr per year.

To take up the slack in power output until these developments are completed an economy campaign started in 1944 is being continued. The objective in 1945 was to save 500,000,000 kwhr. At mid-year 335,000,000 kwhr had been saved in nonessential uses.

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BPA Expects to Recover War Load

Successful attempts by the federal government to get the aluminum reduction and fabrication facilities in the Pacific Northwest back into operation under private management have brightened the power marketing picture of the Bonneville Power Administration to a point where BPA confidently expects to have recovered by the end of 1947 all the war load it lost up to last Dec 31.

Biggest factor in BPA's confidence is leasing of Spokane aluminum reduction plant and rolling mill to Henry Kaiser and leasing of Troutdale aluminum plant to Reynolds Metals, Inc. Kaiser expects to be in full operation in a year and Reynolds by the end of this year. When it operated at top levels during the war, the Spokane plant required 245,000 kw. The Troutdale load was 130,000 kw. These two loads, when restored, will bring back the major share of the 500,000 kw of war load which Bonneville lost between VE-Day and last Dec 31.

The remaining 125,000 which must be sold to recover war-load losses may be peddled to active prospects for several other war plants in the area, including a ferro-silicon plant at Wenatchee, or may be absorbed by increases in loads of private companies served at wholesale by BPA. Bonneville officials expect that utility loads will have increased by 125,000 kw—the remaining war load which is to be recovered—by the end of next year.

Maximum firm war load on the system was about 1,300,000 kw. Maximum firm load last Jan was about 800,000 kw. The system has 500,000 kw of capacity at Bonneville Dam and another 720,000 kw at Grand Coulee. Grand Coulee's capacity is temporarily less than it was during the war because of the removal of two 75,000-kw generators, designed for California's Shasta Dam but installed in three Coulee foundations because Shasta was not ready to use them and no machines were ready for the Coulee power house at the time.

By the time BPA's load returns to the wartime firm peak of 1,300,000 kw at end of next year. Coulee will have Unit L-9, rated at 108,000 kw but considered by BPA to be good for 120,000 kw in operation. Shortly thereafter, Units L-7 and L-8 will be on the line, bringing the system's peaking capacity to 1,580,000 kw.

How to Buy Surplus Machine Tools is available on request to National Machine Tool Builders' Association, 10525 Carnegie Ave, Cleveland 6, O. It gives pertinent suggestions on how to go about buying government-owned surplus machine tools. Surplus sales and information offices in the U. S. are listed. Formula for determining prices of standard, general-purpose surplus machine tools are given. Government regulations affecting sale of surplus machine tools, as issued by the Surplus Property Administration, are also listed.

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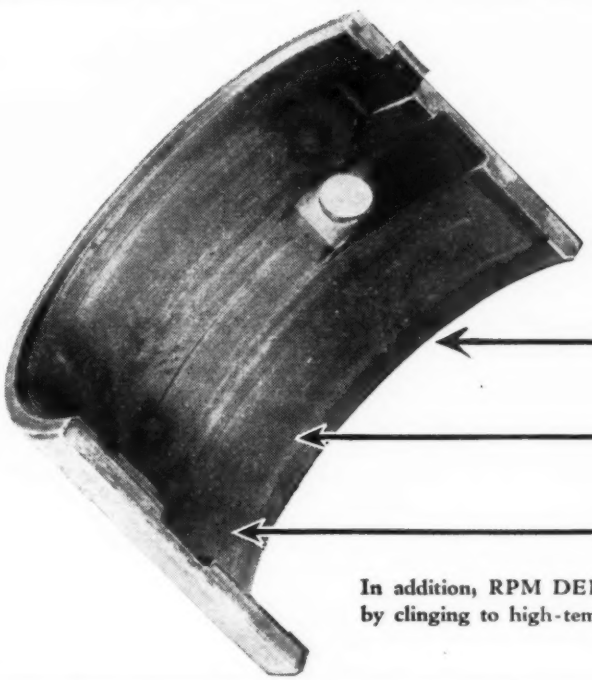
The high pressures and temperatures in present-day Diesel engines greatly accelerate oxidation of some lubricants. Under such conditions, these oils tend to become corrosive and attack the lead in the copper-lead structure of alloy bearings. This leaves a porous copper shell which breaks down under pressure. The illustration shows how an alloy bearing looks after operation with an uncompounded oil.



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OPA Suspends Equipment Price Ceiling Further

Office of Price Administration has taken a new step in its program of suspending price controls on electrical transmission equipment, other than wire and cable, by suspending ceilings on several specific types of equipment. The suspension is based on the fact that the job of continuing controls would not merit the work involved. It is also expected that prices of the affected items will not rise above the levels to which ceilings would have to be boosted had price controls been retained.

OPA's action, in Amendment 24 to its Supplementary Order 129, suspends price control on the following items:

"Coils, specifically designed and made for motors, generators, transformers or related equipment

"Distribution cutouts not including building equipment and supply items (as defined in the National Electric Manufacturers' Association Manual but not including items under Section 5 of that manual)

"Specified high-voltage insulators including only the following: wet-process porcelain or glass low-voltage pin-type insulators; high-voltage insulators including posts, clamps and other variations; guy strain insulators; spoon type insulators; suspension insulators including hewletts; outdoor switch and bus insulators of all types including posts; special and apparatus insulators except those with metal parts but including tubes and wall, roof and floor bushings; hi-line or suspension hardware including clamps and associated fitting

"Pole line hardware and line construction specialties

"Power switching equipment except that of 601 v or lower

"Repair and replacement parts designed for use in equipment suspended from control if the parts are or have been supplied by the manufacturer of the equipment were recently suspended from price control." OPA's action broadens this suspension to include parts sold to other manufacturers of the same commodity for use as original equipment. However, the suspension still applies only where parts are sold by maker of complete equipment or where parts are sold by a reseller to whom they were supplied directly or indirectly by maker of complete equipment.

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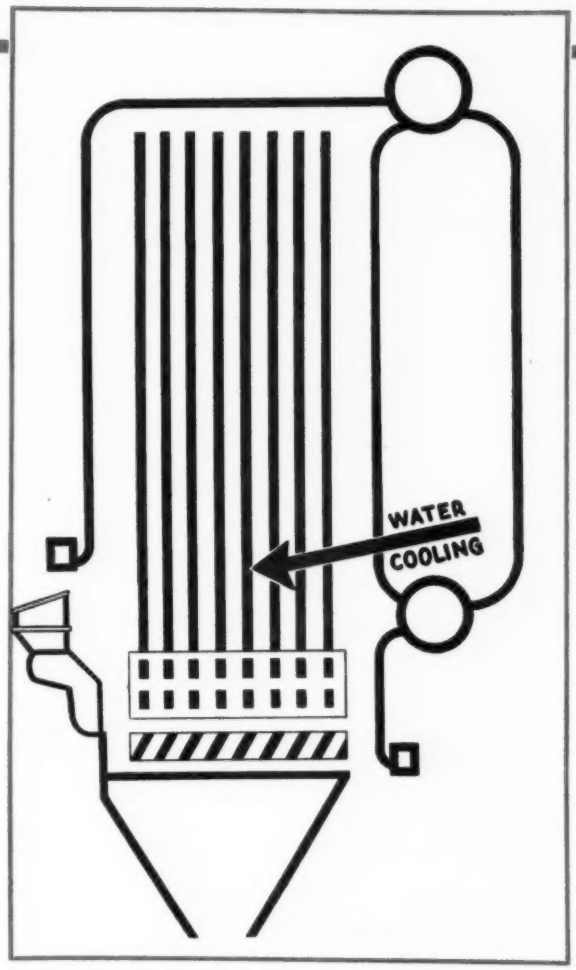

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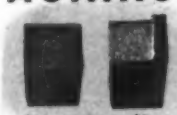
PROTECTS REFRACTORIES AGAINST ABRASION



REFRACTORY BRICK of same quality – one coated with Brickseal and the other uncoated – were forced against an emery wheel turning at 1800 rpm. The Brickseal-coated brick glowed red from the friction and was not cut or affected, while the uncoated brick was easily disintegrated.

Brickseal consists of high fusion clays and metal oxides combined in oil. Furnace heat burns away the oils and vitrifies the clays and metals. Brickseal prevents cracking, spalling and slagging regardless of temperature changes.

TRY IT YOURSELF

Two bricks bonded together and partially coated with Brickseal will be mailed to you on request.

BRICKSEAL
REFRACTORY COATING
5800 So. Hoover St., Los Angeles, Calif.
1029 Clinton St., Hoboken, New Jersey

Manufacturers Perfect Heat-Pump Specifications

A tentative set of specifications, covering design of a self-contained heat-pump air-conditioning unit and manufacture of 1000 units for a group of electric utility companies, has been sent to eleven manufacturers by American Gas & Electric Service Corp.

Philip Sporn, executive vice-president, stated that the manufacturers have been asked to comment so that revisions in the specifications can be made to yield a design having: (1) high reliability (2) economical performance (3) reasonable first cost (4) low operating cost (5) compactness and (6) neat appearance.

The heat pump as a house heating and air-conditioning device has attracted considerable attention during the past year and several utility companies have supported research for its perfection.

The Pacific Coast Electrical Association, Inc, has formed a group, known as the Air Heating Research Committee, to investigate the potentialities. At the recent annual conference the Southeastern Electric Exchange authorized its heat pump committee to work with American Gas & Electric on this work. Commonwealth Edison Co has set up a research group under auspices of the Utilities Research Committee.

Ohio Power Co is now installing in the control building of the new Tidd power plant, Brilliant, O., a 15-hp heat pump using air as the heat source, in combination with an offpeak heating and cooling storage tank.

Mr. Sporn stated that the primary reason for suggesting ordering 1000 units at the start is to enable manufacturers to devote a substantial amount of time and effort in research, development and design to properly correlate the various requirements and produce a highly dependable and economical unit.

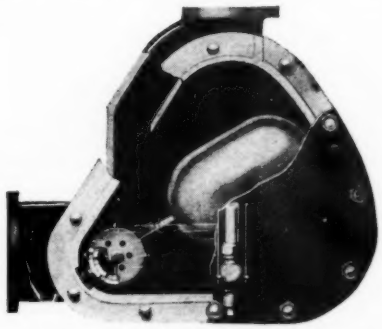
Specifications also have been sent to about 50 utility companies for their comment. Others interested can obtain the specifications from American Gas & Electric. He suggested that a qualified man should be appointed to meet with representatives from other companies and with an advisory board to be set up to prepare a final set of specifications.

It is our thought, Mr. Sporn declared, that the final specifications will be so drawn as not to favor or discourage any particular heat pump operating cycle, nor to limit a manufacturer to any given equipment design or arrangement. On the contrary, the aim will be to allow the specifications to act as a stimulant to the manufacturer to design and develop an original, outstanding and efficient self-contained heat-pump unit.

Great possibilities are also seen by Mr Sporn in small heat-pump units for domestic hot-water service. Specifications for this equipment are now being worked out by American Gas & Electric.

Manhattan Rubber Div, Raybestos-Manhattan, Inc, Passaic, N. J., received one of the first annual awards of American Public Relations Assn for a meritorious 1945 public relations performance.

ENORMOUS CAPACITY



Cochrane Multiport Drainers have exceptionally high capacity at low pressure due to the large multiport areas.

They are particularly effective in carrying away heavy momentary slugs.

They are instantly responsive due to the balanced rotary valve with only one moving element and no stuffing box.

COCHRANE
SINCE 1863
DRAINERS

THEY PROVIDE CONTINUOUS DRAINAGE

THEY ARE COMPACT—OCCUPY VERY LITTLE SPACE

THEY ARE SURPRISINGLY LIGHT IN WEIGHT

Write for a copy of Publication 2925

COCHRANE CORPORATION
3106 N. 17th St., Phila. 32, Pa.

COCHRANE STEAM SPECIALTIES

DISSOLVED OR ENTRAINED AIR

in circulating water—one of many factors governing condenser tube and heat exchanger tube performance—is presented in this discussion by Scovill engineers on selection of the proper tube alloy.

Fast-flowing rivers, rapidly changing tides, spray ponds and moving ships all create a condition causing entrainment of air. Furthermore, all raw water is saturated with dissolved air. Approximately 2.7 cu. ft. of air will dissolve in 1000 gal. of water — the quantity of air to saturate being dependent on the water pressure, composition and temperature. Any low-pressure areas in the circulating system permit the liberation of part of this dissolved air to ally itself with any free air in its erosive-corrosive attack on the tubes.

In actual operating conditions, where dissolved or entrained air in the circulating water is only one of the variables, tube life depends on the nature and/or extent of such other factors as: Velocity and turbulence of coolant . . . Chemical composition of circulating water . . . Temperatures inside and outside of tubes . . . Chemical or electro-chemical actions . . . Marine growths or other deposits . . . Sewage and wastes present . . . Development of protective film . . . Media surrounding tubes.

One of the principal objects of Condenser Tube Technical Research has been the development of alloys designed to give the user longest tube life and most trouble-free service. Where the major factor affecting tube life is the presence of dissolved or entrained air, satisfactory alloys include Cupro-Nickel, Aluminum Brass and Phosphorized Admiralty, each within its temperature limitations.

The conditions surrounding any given condenser or heat exchanger tube application are so many and varied that each installation must be treated as an individual problem.

Scovill has made and is making extensive studies of condenser and heat exchanger tube service conditions for every known application, and offers the facilities of its Technical Service Department to aid in the selection of suitable tube alloys to meet specific service conditions, in an existing or proposed installation.

THREE SCOVILL SERVICES

Scovill's *Service in Men* offers specialized consultation on individual tube application problems and suggestions regarding alloy selection and tube installation practice. *Service in Metals* includes development and production of a broad range of tube alloys under laboratory control, which verifies that Scovill alloys conform to requirements of specifications. *Service in Manuals* consists of literature providing the latest, most authentic information on condenser and heat exchanger tubes, which has its source in the broad experience of our engineers and the findings of our laboratories. For a free copy of the *Condenser Tube Booklet*, address Scovill Manufacturing Company, 13 Mill Street, Waterbury 91, Connecticut. *Export Department:* 405 Lexington Ave., New York 17, N.Y.

SCOVILL

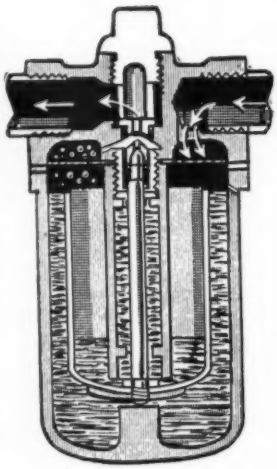
SCOVILL

CONDENSER TUBES

One Product • Three Services

Service in Manuals . Service in Metals . Service in Men

STICKLE *Open Float* STEAM TRAPS



Efficient Drainage

Correct adaptation to drainage problem and proper installation are the only requirements for perfect service with Stickle Steam Traps. Abundant capacity. Operation perfectly simple, perfectly natural. When Open Float, or bucket, loses buoyancy, the trap opens for discharge. Regained buoyancy closes trap. Both actions instantaneous. Movement, up or down, small fraction of an inch. No friction, no sticking, no blowing of steam at end of discharge. Air and gases eliminated with each discharge.

Trouble-free Operation

Stickle Traps eliminate mechanical difficulties. There are no levers or hinges—no unnecessary parts to wear out or get out of order. Only moving part is Open Float. Small valve attached to bucket rod rotates with bucket as trap discharges giving continuous regrind to valve and valve seat to maintain smooth surfaces and proper fit.

Long Service Life

Many users say you can install a Stickle Trap and forget it! We are frequently told of Stickle Traps in constant use, and giving perfect service, for ten years and longer without repairs or even examination.

Series Designs and Sizes To Meet All Requirements

There is a Stickle Trap for practically any industrial requirement—traps for drainage of equipment operating at low, medium and high pressures or with vacuum systems—in series design to meet specific operating conditions and in sizes for handling required volumes of condensate.

The Stickle Open Float

Basic to every Stickle Trap, the Stickle Open Float represents an obvious, simple and positive steam trap operating principle. It avoids complicated mechanism—therefore avoids trouble. Its action is natural—therefore almost effortless. It makes possible a rhythmic never-tiring performance, giving traps full efficiency and complete dependability.

Bulletins on Request

No. 115—Series 100 Stickle Traps, for straight-in-line installation. Capacity range, 250 to 5,000 lbs. per hour. Pressure range, 1 to 250 lbs.

No. 315—Series AE Stickle Traps, Capacity range, 5,000 to 40,000 lbs. per hour. Pressure range, 10 lbs. to 200 lbs.

No. 415—Series T Stickle Traps for low and medium pressures—including radiator traps, small and large utility traps and extra large capacity traps—and large capacity traps for vacuum service.

No. 515—Series 50 Stickle Traps for handling extremely large volumes of condensate from high pressure units.

OTHER STICKLE EQUIPMENT

Stickle Differential Drainage and Boiler Return System—a closed pumping system that returns condensate under pressure from processing units to boilers at temperature only slightly lower than that at which it leaves traps. Bulletin No. 250.

Stickle Regulating and Reducing Valves—two series in standard types designed and constructed for industries requiring dependable and accurate control within extremely close limits of variation. Bulletins Nos. 235 and 435.

Stickle Open Coil Feed Water Heaters—small to large capacities, deaerating and non-deaerating types, cast iron or steel construction. Bulletin No. 117.

STICKLE STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE, INDIANAPOLIS 1, INDIANA

SPECIALIZING FOR MORE THAN 40 YEARS IN REDUCING THE COST OF STEAM

Annual Meeting of Edison Institute

At the annual meeting of Edison Electric Institute, June 3-5, two of the important subjects considered were whether atomic energy can replace coal and water as the nation's principal source of electric power in the near future and the possibility of new developments in electric house heating revolutionizing residential use of electricity throughout the country. C W Kellogg, institute president, opened the meeting with a review of the utility industry's record during 1945 and a considered forecast of what the next few years are likely to bring.

Four authoritative speakers examined atomic power and its possible applications in public service. They are Dr Kenneth H Kingdon and Dr C G Suits of General Electric Co's research laboratory; Harry A Winne, GE vice-president in charge of engineering policy; and Dr John C Parker, vice-president, Consolidated Edison Co of N. Y.

The electric house heating system, now in limited production and making its commercial bow this year, was discussed from the viewpoint of its possible application in two widely differing climatic areas of the U. S. J H Polhemus, president, Portland General Electric Co, Portland, Ore., and J M Barry, vice-president, Alabama Power Co, Birmingham, Ala., were the speakers.

Seven techniques in introducing a "Productive Power" exhibit which is soon to tour the nation to help industry solve many of its production problems were given by C B Stainback, manager of Westinghouse Electric Corp's industrial department. Productive Power covers seven applications: adequate wiring, resistance welding, lighting, electric furnace brazing, infra-red drying, radio-frequency heating and air handling and conditioning.

PRODUCTIVE POWER

The electric industry is satisfied, Mr Stainback pointed out, that sustaining and improving our standard of living is dependent on continued increase in utilization of electric power in industry. *Productive Power* is a contribution to this nationwide effort to promote further electrification of American industry. It is a traveling forum that will bring to countless American people for the first time a cross section of a modern industrial plant demonstrating the actual operation of highly developed electrical processes largely responsible for the high standard of living they enjoy.

Tomlinson Fort, manager of Westinghouse's central station sales, declared that installation of these seven electrical processes, along with lesser war-born developments, would increase by 27% the amount of hp at the command of each worker over the amount at his disposal during the height of the war production.

J M McKibbin, Westinghouse assistant to vice-president who directed the *Productive Power Show* declared that manufacturers will be extremely dependent in the future upon all electrical devices to meet successfully the challenge of survival and growth. This program has been prepared to help manufacturers thoroughly analyze their problems and adopt most efficient methods to meet their specific needs.

If you need a long-life compressor...one that has the stamina to generate Air Power continuously at full capacity, 24 hours every day, week after week...*you need an Ingersoll-Rand Class "ES."*

This heavy-duty compressor is designed, built, tested, and rated for severe service throughout many years. In addition, it is the most efficient, trouble-free single-stage compressor available. For these reasons an "ES" will save you hundreds, perhaps thousands, of dollars during its lifetime.

Whenever you have problems concerning Air Power... its generation, its distribution, or its thousands of labor-aiding uses...call on an I-R Engineer. He can help you in many ways.

WITH "ES" *Heavy Duty* COMPRESSORS

- Sizes 5 to 125 hp.
- Liberal valving with Channel Valves.
- Free-air unloaders on each inlet valve.
- Thorough water-jacketing around all valves.
- Completely accessible, oil-tight frame.
- Double-row Timken bearings.
- Constant-speed control; or dual control, permitting either constant-speed or automatic-start-and-stop.
- Pressures 5 to 150 psi single stage.
- Also to 500 psi two-stage; 2500 psi three-stage.
- V-belt, flat-belt, or drive by synchronous motor mounted on crankshaft. Also steam drive with steam cylinder between air cylinder and frame.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 1-772

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

Gives You

LONG, TROUBLE FREE SERVICE!

Fig. 1635

"STANDCO"

PILLOW BLOCKS

The attractive "Standco" Pillow Block shown above is sturdily built and is offered in a wide range of sizes. Babbitted and broached bearing surfaces, accurately machined faces. Can be amply lubricated.

Write for Bulletin

"Unbrako" and "Hallowell" products are sold entirely through distributors.

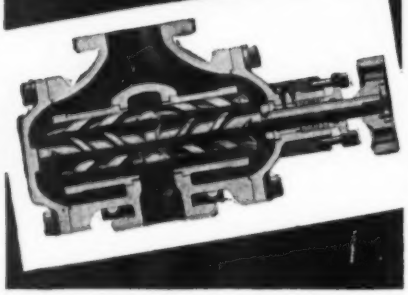
Over 43 Years In Business

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA., BOX 577

Boston • Chicago • Detroit • Indianapolis
St. Louis • San Francisco

NO GEARS



The IMO PUMP requires no gears, because the fluid pumped is propelled from suction to discharge by the action of three intermeshing rotors. That's all there is to it—no gears, valves, vanes or pistons!

For simplicity, reliability and compactness select the IMO—for use in hydraulic service, governor service, lubrication service and other fluid handling services.

For further information send for catalog I-132-P

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

GE Builds Largest 1000-F Turbine Unit

Announcement of a 100,000-kw maximum-rating turbine-generator for operation at inlet conditions of 1250 psi and 1000 F at 3600 rpm has been made by turbine div of General Electric Co. The new unit, now under construction at the Schenectady works and scheduled for delivery in the early part of 1947, is the largest of its kind in the world, and will be used at the Essex Station of Public Service & Gas Co of N. J.

The tandem-compound double-flow machine is 77 ft long and will operate at the highest steam temperature so far undertaken for a unit of this capacity. There are 19 high-pressure stages and five stages in the double-flow low-pressure side. The last-stage wheel carries a new 23-in. bucket of variable-angle double-warped airfoil section. Maximum tip speed of the buckets is 1390 fps. Special provisions are made in the low-pressure turbine for greater removal of moisture and therefore further reduction of moisture-cutting on buckets.

The generator, largest 3600-rpm machine ever constructed, is rated 95,000 kw, 0.85 pf, at 15-psig hydrogen pressure. Set is also equipped with a 7500-kw direct-connected house alternator. Hydrogen cooling of generator is by four vertical cooler sections mounted in corners of generator. Stator core of generator is of modern spring-mounted construction.

War Assets Corp Sells Industrial Power Plants

War Assets Corp announced sale of one war-born industrial power plant and the offering of two others for sale or lease.

Sold to Humble Oil & Refining Co was a toluene plant at Baytown, Tex., in which was installed a 3750-kva full-condensing turbine-generator and five 172,000-lb-per-hr boilers. The plant was operated in parallel with other generating facilities in a neighboring plant, of Defense Plant Corp, also operated by Humble during the war.

Previously offered for sale or lease was the other Humble Plant at Baytown, identified by Plancor No. 1082.

Offered for sale or lease were plants operated by Southport Petroleum Co at Texas City, Tex., identified by Plancor No. 591. Installed therein is a 100-kw steam turbine exhausting at atmospheric pressure and taking steam from the plant's process line and a plant operated by Wilshire Oil Co, at Norwalk, Calif., identified by Plancor No. 912. The plant contains two 800-kw condensing units and a 100-kw unit exhausting at atmospheric pressure, and two 125,000-lb-per-hr oil-fired boilers. This equipment is of special design for oil refining.

Loughnan St. Lawrence Pendred retired April 1 after serving the journal *The Engineer*, published in London, England, for 50 years and occupying the editorial chair for 40. He became editor in 1905 in succession to his father, Vaughan Pendred, who had himself been editor 40 years. Now Loughnan Pendred is to be succeeded by his son, Benjamin, as editor of the journal.

3 Questions

that engineers ask and the

"Saucer Test" Answers about

NCC

SLUDGE SOLVENT

AND FUEL OIL CONDITIONER

Will NCC dissolve even the hardest sludge?

Does NCC contain caustic?

Is NCC neutral and acid-free?

Here's All You Need To Make The "Saucer Tests" In Your Own Office

a saucer from the five and dime

a few drops of Phenolphthalein from a drug store

a few drops of Methyl Orange from a drug store

a few ounces of NCC (which we will furnish FREE)

TEST FOR SLUDGE

Place some sludge in a saucer (a scraping from the fill pipe is an easy way to get some). Add enough NCC to cover completely. Right before your eyes you will see the sludge dissolve.

TEST FOR CAUSTIC

The accepted test for caustic in a liquid is the addition of Phenolphthalein which turns the tested liquid pink if it contains caustic. Into a saucer pour some NCC. Add a few drops of Phenolphthalein. NCC will remain water-white, proving that it contains no caustic.

TEST FOR ACID

The accepted test for acid in a liquid is the addition of Methyl Orange which turns the tested liquid pink if it contains acid; yellow, if acid-free. NCC turns yellow, proving that it is neutral and acid-free.

NCC, for test, FREE on request.

NUTMEG CHEMICAL CO.

223 State St., New Haven 10, Conn.

Operating Cost Savings

ENGINEERED INTO PIPING BY *NAVCO*

Careful and expert preliminary engineering work by Navco Engineers, in addition to employing the most modern fabricating and erection methods, are your guarantee of operating savings.

Consult Navco for just a Pipe Bend, or a complete Piping System.

★ Assured Safety

★ Efficient Operation

★ Minimum Fuel Costs

★ Low Maintenance

★ Long Trouble-Free Life

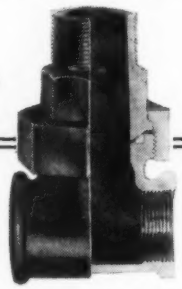
NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

JEFFERSON *Specialty* UNIONS
featuring the RECESSED BRASS SEAT



Assure leakproofness, self-seating and free-flow

Jefferson Union Tees are included in the Jefferson line of Specialty Unions along with 45° and 90° union elbows so that the advantages of Jefferson design are made available from one source.

Jefferson Union Tees are used in place of all-female unions to save nipples and ordinary tees. Made in All- Female and Male-Female types.

Preference for Jefferson Unions centers in the assured leakproofness, ease of application, self-seating and unobstructed bore achieved by the Recessed Brass Seat, exclusive with Jefferson. A true machined and precision ground joint, so located as to eliminate the possibility of pipe ends coming in contact with it and assuring free-flow, provides *surface* contact and can be made up without the application of undue pressure.

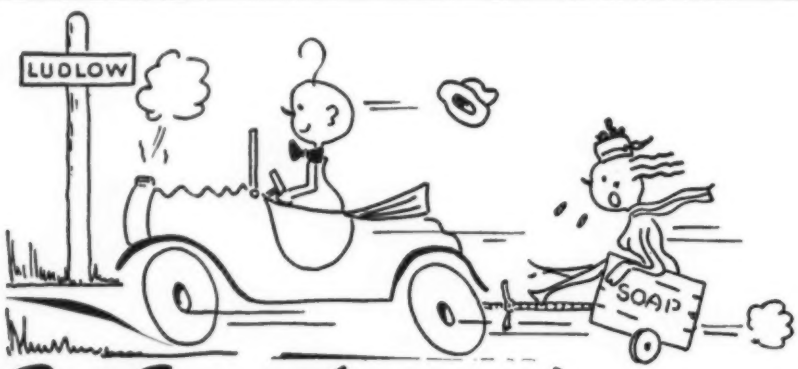
Jefferson Unions are designed to facilitate piping installation and the use of Specialty Unions assures better, simpler jobs with worthwhile savings in time and labor.

If your nearest distributor is unable to supply your requirements, get in touch with us direct for prompt service.

JEFFERSON UNION CO.

601 WEST 26th STREET, NEW YORK 1, N. Y.

LEXINGTON 73, MASS. LOCKPORT, N. Y.



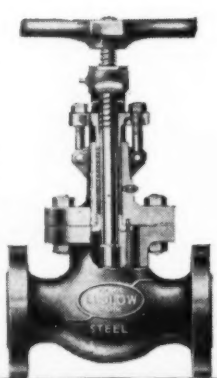
Back Seating Arrangement!

For "Helpful Henriettas" — and repacking LUDLOW Steel Globe Valves under pressure.

Another LUDLOW "Plus" feature — a special back seating arrangement, engineered by LUDLOW, which permits repacking the box, while the valve is under pressure!

You'll also find built into LUDLOW Valves for the continued approval of operators, engineers, and maintenance men, a hardened steel disc that takes the stem thrust and prevents seizing. The disc is readily secured to the stem to simplify regrinding, and a variety of disc and seat ring materials is available for positive seating under any kind of service.

Time and trial have proved LUDLOW Valves are long-lasting, efficient, economical. Write today for complete catalogs.



V-4

The LUDLOW VALVE MFG·CO·INC·TROY·N·Y· SINCE 1866

APPOINTMENTS

De Laval Steam Turbine Co announces appointment of James P Stewart as special representative for centrifugal blowers and compressors. He will make his headquarters in Trenton, N. J.

L W Stolte has been elected secretary of **Fairbanks, Morse & Co,** replacing Fred C Dierks who retired.

J S Coffin, Jr, Co has made James R Coe, 220 W 42nd St, New York, N. Y., their sales representative.

Gilbert H Krohn has been appointed manager of sales of the Detroit district sales office of **Globe Steel Tubes Co.** Mr Krohn succeeds Arthur A Loeffler who retired. Willard C Christianson has been transferred to Chicago district sales office as sales agent. Frederick K Krell has been made sales service supervisor, with headquarters in Milwaukee, Wis.

Republic Flow Meters Co moved its branch office from Carew Tower to Boesch Bldg, located at 3197 Linwood Ave., Cincinnati 8, O. Frederick H Meyers has been appointed manager of the Cincinnati district which includes central and southern Ohio and eastern Kentucky.

C V Gregory has been elected district manager in Pittsburgh for **Reliance Electric & Engrg Co.** Mr Gregory succeeds Bon J Ballard, who becomes assistant to sales vice-president.

Eight engineers rejoin **Bailey Meter Co** after being released from military service: J A Lucas has been assigned to his former position in Cincinnati office; J W Herrington to the Atlanta office; J E Zimmerman to the Detroit office; A L Danielsen to Denver district; S T Novak to position of quality engineer at Cleveland factory; H R Jamieson to proposition dept in Cleveland; H C Schink to Boston office; Vincent Beno to development work in research dept. W L Thompson, manager of Toronto branch office, and W A Nelson, of the Canadian head office at Montreal, returned to the company's Canadian subsidiary, Bailey Meter Co Ltd.

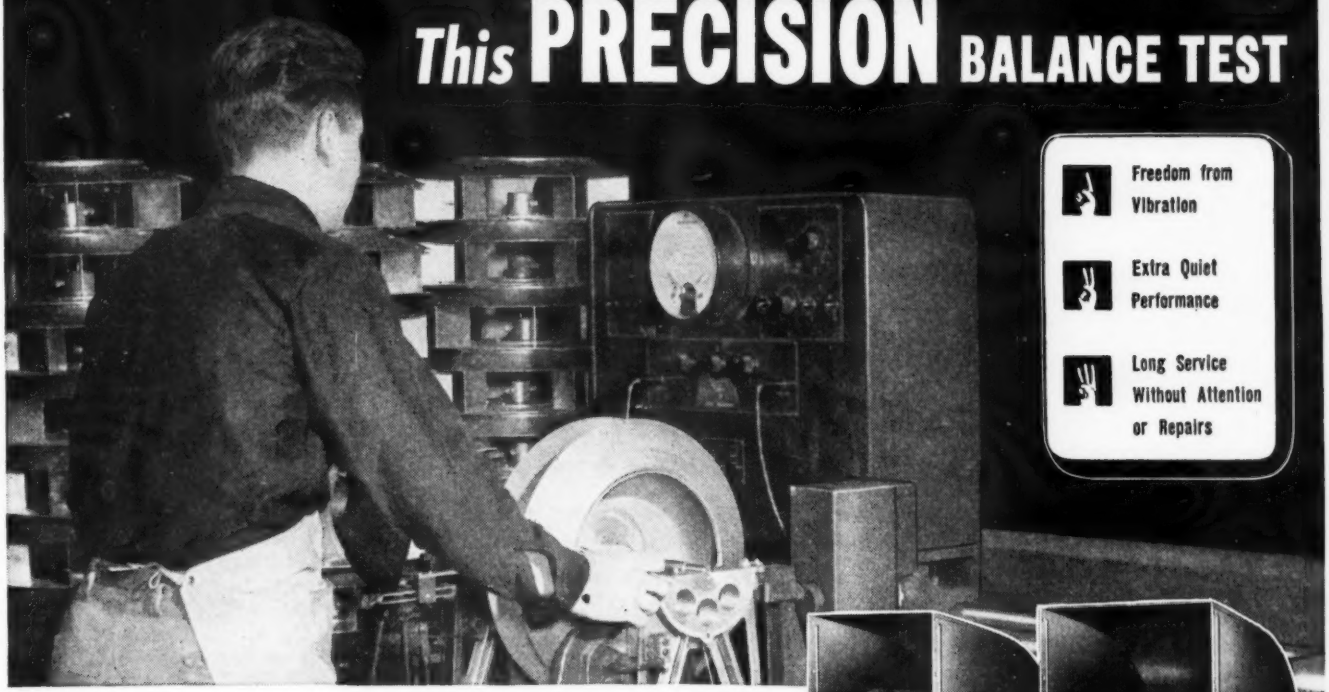
Elliott Co names J N McClure manager of petroleum div, with headquarters in Houston, Tex.; C F McGinnis manager of Kansas City district; and J E Walsh manager of Houston, Tex., district office.

Sidney M Cadwell has been made director of research and technical development of **U. S. Rubber Co,** with headquarters in New York City. Willis A Gibbons becomes associate director. He will devote all of his time to scientific research. Walter C Burns has been appointed district sales manager of mechanical goods div in San Francisco. Mr. Burns will have supervision over mechanical goods sales in northern Calif. and most of Nev., including San Francisco, Sacramento, Stockton, Fresno and Reno.

George P Torrence rejoins **Link-Belt Co** as executive vice-president and will become president on Nov 1, 1946, at which time William C Carter retires as president. Board

Every Wheel Must Pass — with Honors —

This PRECISION BALANCE TEST



- Freedom from Vibration
- Extra Quiet Performance
- Long Service Without Attention or Repairs

WHEELS in perfect balance are of utmost importance — if the fans you use for air conditioning, ventilation, industrial process work and/or mechanical draft are to give satisfactory, long-time service.

That's why we take such great pains with our wheel balancing operations! Clarage fan wheels are tested on highly sensitive, electro-dynamic machines as shown above. *Both static and dynamic balance are obtained simultaneously — and to within close precision limits.*

And accurately balanced wheels are but one of many safeguards placed around Clarage air handling units that they may be able to operate year after year with minimum attention and repairs.

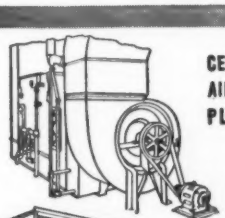
Yes, you can have absolute confidence in Clarage equipment whatever your air handling requirements!

We build centrifugal fans from 200 to 100,000 c.f.m. and larger, suitable for every type of industrial, commercial and public building service.

Write for Clarage Catalog showing our complete line.

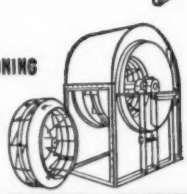
SOME OF OUR OTHER PRODUCTS

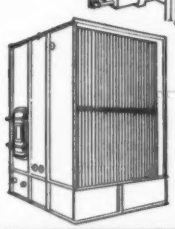
UNIT HEATERS



CENTRAL STATION AIR CONDITIONING PLANTS

LARGE AIR CONDITIONING AND VENTILATING FANS





AIR WASHERS

CLARAGE

FAN COMPANY

Kalamazoo, Michigan

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

in "DIVIDENDS FROM YOUR POWER PLANT"

What's Your Billing in the Front Office?

"Dividends From Your Power Plant" tells *your* story to the front office. This authoritative booklet gives management a clear interpretation of *your* job . . . *your* capacities . . . *your* relation to profits and production.

It goes farther than Webster in defining the industrial plant engineer as a "plotter", "designer", "inventor" "contriver". It says that "The Engineer is a Gold Mine"—and proves its point! It describes how industry can profitably plan for the future by working closely with the plant engineer and carrying out his suggestions, his blueprints for improved power generation.

Yes, "Dividends From Your Power Plant" is *your* story. But, remember, it was written for the non-technical executive to help *him* understand the problems of efficient, practical power generation. Get your copy* — free, of course — After you've read it mark it for the front office. Such articles as "If Steam Were A Raw Material", "Stack or Fan for Draft", "Steam Isn't Frazen" will show management how closely related your job is to "profits from power".

***Incidentally, this 36 page booklet contains no advertising.**

PREFERRED UTILITIES MANUFACTURING CORPORATION
1860 Broadway, New York 23, N. Y.

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PR-127

PREFERRED UTILITIES MFG. CORP.
1860 BROADWAY NEW YORK 23, NEW YORK

Please send me FREE and without obligation, bulletin #1000 and the ten articles in booklet form, titled—"Dividends From Your Power Plant".

Name.....

Company Name.....

Street.....

City.....**State**.....

P-7-46

PREFERRED UTILITIES

Ripped for Results — PREFERRED UTILITIES ENGINEERS

of directors created an executive committee consisting of directors Howard Coonley, Russell Livermore and W C Carter. Mr Carter is chairman. Company opens three new sales offices: A new office at Moline, Ill., is located at 1608 Fifth Ave., with M J Parykaza, district sales engineer, in charge. Mr L R Clark, district sales engineer, is in charge of new office at 730 Temple Bar Bldg, Cincinnati 2, O. An office has been opened at Birmingham, Ala., at 823 Comer Bldg., with C C Wiley, district sales engineer, in charge.

Elgin Softener Corp announces appointment of two new southern representatives: Watson & Watson, with headquarters in Knoxville, Tenn., will cover eastern Tennessee, North and South Carolina and western Virginia. W Harwell Allen, with headquarters in Nashville, Tenn., will cover western Tennessee, northern Mississippi and northern Alabama.

A P Hall has been elected vice-president of **American Chain & Cable Co.** He will continue his present duties as general manager of sales, and his headquarters will remain at 230 Park Ave, New York City.

General Controls Co added F E Weldon and A C Kelterborn to the New York factory branch sales staff. New York factory branch serves N. Y., N. J. and Conn.

J F Weller has been appointed to the newly created post of sales assistant to president of **American Brake Shoe Co.**

New dealership appointments announced by **Davey Compressor Co,** Kent, O., are: C A Lippincott & Bro Co, 3rd & Union St, Morristown, N. J.; Jones-Rogers Co, 418 Schofield Bldg, Cleveland, O.; Phillips Machy Co, 900 E Cary St, Richmond, Va.; Phillips Machy & Tractor Co, 325 W 23rd St, Baltimore, Md.; and Phillips Machy & Tractor Co, P O Box 549, Alexandria, Va.

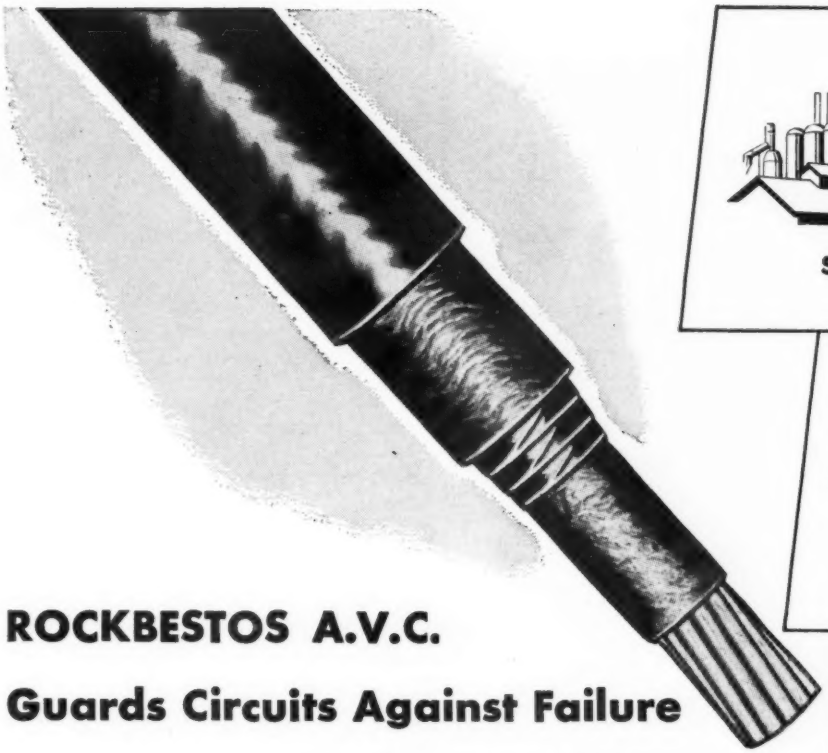
Dampney Co of America appoints K E Greene to sales staff at Chicago and W T Campbell to sales staff at Philadelphia.

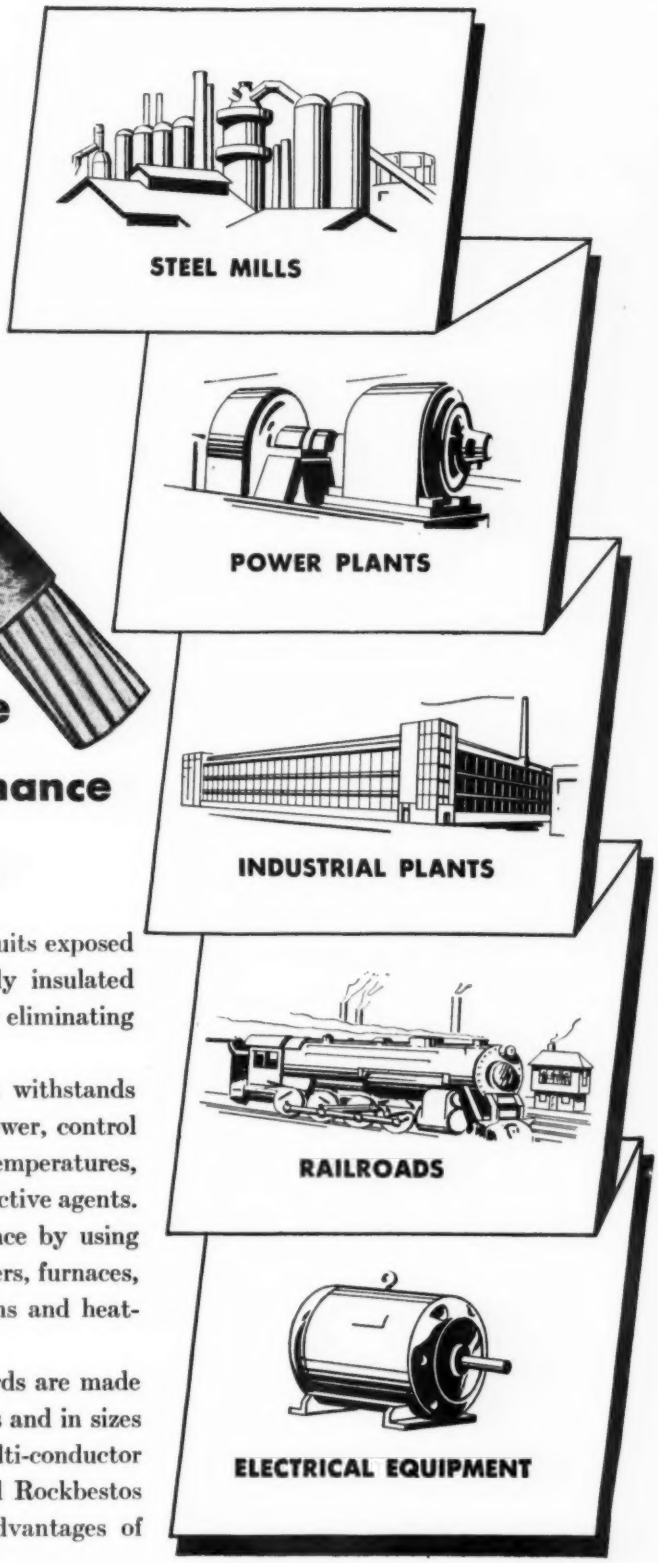
Appointment of Edwin L Hobson to sales staff of **Monsanto Chemical Co's** plastic div was announced. Mr Hobson will spend several months at the Springfield plant and will then be assigned to one of the division's branch offices.

Robins Conveyors Inc announce retirement of C C Brooks, who was western manager of hoisting machinery div, with his headquarters in the Chicago office.

Hewitt Rubber Corp has changed its name to Hewitt-Robins Inc, thereby bringing in the identity of its wholly owned subsidiary, Robins Conveyors Inc. All officers were reelected. Harold H Von Thaden, first vice-president of Robins Conveyors, was elected a director of Hewitt-Robins Inc.

F K McCune and B R Prentice have been appointed members of **General Electric Co's** apparatus design engineering staff, reporting to E E Johnson, manager of engineering in apparatus dept. Mr McCune will coordinate engineering cost reduction activities among other duties at Schenectady. Mr





ROCKBESTOS A.V.C. Guards Circuits Against Failure and Reduces Electrical Maintenance in Factories, Mills and Utilities

The reason you find so much Rockbestos A.V.C. in circuits exposed to severe operating conditions is that these permanently insulated wires, cables and cords guarantee dependable operation by eliminating wire-failures.

The *impregnated asbestos insulation* . . . an armor that withstands heat, aging, corrosive fumes and moisture . . . insures power, control and lighting circuits against failure in high ambient temperatures, under overloads, or exposure to oil, grease and other destructive agents.

Eliminate repeated re-wiring and expensive maintenance by using Rockbestos wires, cables and cords in circuits around boilers, furnaces, kilns, soaking pits . . . and in steam tunnels, pump rooms and heat-exposed ducts.

Permanently insulated Rockbestos wires, cables and cords are made in 125 different standard types in 300 to 5000 volt ratings and in sizes up to 2,000,000 CM. Everything from magnet wire to multi-conductor power cables . . . National Electrical Code types . . . and Rockbestos All-Asbestos constructions. For information on the advantages of *permanently insulated* Rockbestos write for a catalog.

ROCKBESTOS PRODUCTS CORPORATION
145 Nicoll St., New Haven 4, Conn.

The Rockbestos A.V.C. Power Cable illustrated (Type AVA) with an impregnated asbestos and varnished cambric insulation, protected by a heavy asbestos braid, is only one of 125 wires, cables and cords developed for severe operating conditions by Rockbestos. All are designed to resist the destructive effects of heat and moisture, corrosive fumes, grease, oil and flame.

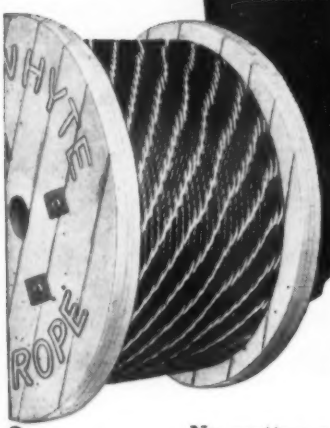
ROCKBESTOS A.V.C.
The Wire with Permanent Insulation
NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS
LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

10 Advantages of NICHOLSON EXPANSION STEAM TRAPS

1. Easily adjusted for any pressure from 0 to 250 lbs. without change of valve or seat.
2. Valve is adjustable for regulating temperature of condensate.
3. Entirely automatic action.
4. Quiet, continuous discharge.
5. Discharge air as efficiently as water.
6. Wide open when cold.
7. No air binding; no freeze-ups.
8. Valve and seat of hardened stainless steel.
9. In various overall lengths, 18" to 40", to suit space.
10. Two types: thermostatic; continuous flow.

FOR complete *details of these effective, low-cost expansion steam traps, send for BULLETIN 444.*

W. H. NICHOLSON & CO. 125 OREGON ST., WILKES-BARRE, PA.



MACWHYTE
Internally Lubricated
WIRE ROPE

RIGHT FOR ALL YOUR WIRE ROPE JOBS

No matter what kind of wire rope your job calls for, Macwhyte can supply it in the correct grade and size.

- Made from selected, laboratory-tested steels.
- Wire is drawn in our own mill under strict metallurgical control.
- Carefully supervised by experienced workmen.
- Highest quality for maximum service, safety, economy.
- PREformed or Non-PREformed.
- Carried in stock by Macwhyte distributors and branch warehouses.

MACWHYTE COMPANY
2944 Fourteenth Avenue, Kenosha, Wisconsin
Makers of the correct rope for your equipment

MACWHYTE COMPANY 50th Year 1896 – 1946

NO. 883

Prentice will co-ordinate design engineering activities in development of nuclear power projects. Harold L Aldrich has been made district representative in New York office of chemical dept. Mr Aldrich will be GE sales representative for Glyptal alkyd resins.

General Electric Co elects George P Lehmann to newly created post of assistant manager of plastics divisions. Guy M Stone has been made manager of Coshocton, O., plant of plastics divisions. The Coshocton factory is now under construction. David FitzGerald has been named manager of employe relations for plastics divisions.

F B Ennis has been appointed manager of manufacturing of **General Electric Co's** wiring device div. Following men have been appointed to GE plants under his jurisdiction: J R Murray is now assistant manager of manufacturing of wiring device div and superintendent of wiring device section at Bridgeport, Conn. C A Devore has been named manager of Mt. Vernon, N. Y., works. H R Geiman is manager of Meriden, Conn., works. E G Hopkins becomes manager of Norfold, Conn., works. R L Priestley is now manager of new Saugerties, N. Y., works. W A Stott has been named manager of Millerton, N. Y., works. H B Turner becomes manager of Lowell, Mass., works.

Wilms, Weaver & Co has been dissolved by mutual consent. Mr Weaver will continue in the same general line under firm name of Charles Weaver & Co, handling steam-turbine generators, general power-plant equipment, diesel engines, etc, with headquarters in Penobscot Bldg, Detroit 26, Mich. Mr Wilms will operate in the future as Walter H Wilms & Co, specializing in general construction and marine equipment, with offices in Guardian Bldg, Detroit.

Following veterans returned to their pre-war jobs in industrial div of **Timken Roller Bearing Co:** R G Harmon, field engineering, Chicago; D G Gibson, field engineering, Cincinnati; S T Salvage, assistant district manager, industrial div, Cleveland; R L Williams, field engineer, Cleveland; F J Hartshorne, field engineer, Milwaukee; and L M Meyer, field engineer, Pittsburgh. L H Gegenheimer, former War Production Board member, is now district manager of industrial div in Boston.

Don G Mitchell was elected president of **Sylvania Electric Products Inc.** Walter E Poor was elevated to chairmanship of board of directors. B K Wickstrum has been appointed general sales manager of lighting products, with office in New York City.

Wright-Austin Co elected following officers: Clark C Wormer, president and general manager; William J Champion, vice-president in charge of production; and H Gordon Wood, secretary.

New York office of **Sterling Engine Co** has moved to 401 4th Ave, New York, N. Y.

H W Tuttle, formerly president, H W Tuttle & Co, Adrian, Mich., has announced severance of his connection with that firm and formation of a new company in Marysville, Mich., to design and manufacture Clairel

B.S.&B. SAFETY HEADS

RECOGNIZED protection for chemical reaction vessels and other pressure equipment containing corrosive chemicals. SAFETY HEADS isolate relief valves from gummy materials which would otherwise render valve inoperative.

Obviously there can be no leakage through a SAFETY HEAD rupture disc, such as is often experienced with a relief valve.

BUT, the important feature is the great capacity. When the SAFETY HEAD rupture disc breaks from over-pressure, you have a full size, straight through relief opening.

WRITE FOR CATALOG TODAY

PRODUCTS B S & B SERVICE

BLACK, SIVALLS & BRYSON, INC.

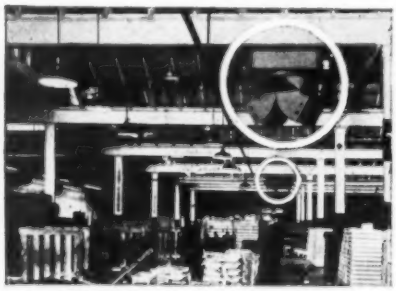
7500 E. 12th STREET KANSAS CITY 3, MO.

WING

Revolving UNIT HEATERS

DO WHAT NO OTHER FORM OF PLANT HEATING CAN DO

Not just another unit heater, the WING REVOLVING HEATER is unique in that it does what no other heater can do—its slowly revolving outlets gently distribute the heat continuously in a constantly changing direction. It reaches over, around and under obstructions into out-of-the-way corners, its moving streams of heated air quickly warm up a plant in the

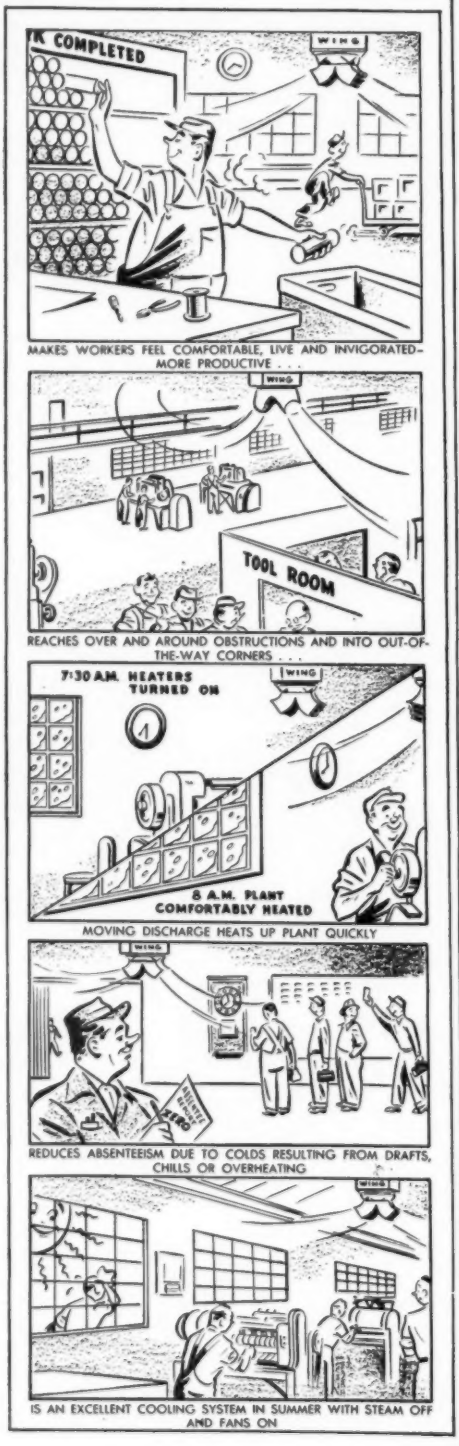


Above: Wing Revolving Unit Heaters in a typical low ceiling type of installation. Revolving Heaters are also made for practically any height roof or ceiling.

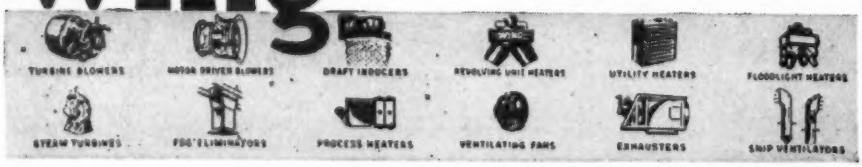
morning and its properly warmed, healthful air currents thoroughly distributed, create a sensation of live, invigorating comfort for the workers. Wing Revolving Unit Heaters are used in many of the country's leading industrial plants. Write for a list of installations.

L. J. Wing Mfg. Co.
50 Seventh Ave.,
New York 11, N. Y.

Factories at Newark, N. J. and Montreal, Canada


K COMPLETED
WING
MAKES WORKERS FEEL COMFORTABLE, LIVE AND INVIGORATED—MORE PRODUCTIVE . . .
WING
TOOL ROOM
REACHES OVER AND AROUND OBSTRUCTIONS AND INTO OUT-OF-THE-WAY CORNERS . . .
7:30 A.M. HEATERS TURNED ON
WING
8 A.M. PLANT COMFORTABLY HEATED
MOVING DISCHARGE HEATS UP PLANT QUICKLY
WING
ELECTRIC HEATER ZERO
REDUCES ABSENTEEISM DUE TO COLDS RESULTING FROM DRAFTS, CHILLS OR OVERHEATING
WING
IS AN EXCELLENT COOLING SYSTEM IN SUMMER WITH STEAM OFF AND FANS ON

Wing REVOLVING UNIT HEATERS



wire-wound industrial heater and resistor components. President of the new organization, **St. Clair Electric Products Co,** is Richard H Asam. As vice-president and general manager, Mr Tuttle is in direct charge of sales and engineering. R H Davis is factory superintendent of the new company. Other officers include John D Scofield, secretary, and Fred E Birtch, member of board of directors.

Bacharach Industrial Instrument Co announces return of A H Anderson, after military service, as manager of heating div.

William A Marshall, vice-president in charge of factory operations of **K-D Lamp Co,** Cincinnati, has been elected a director.

Security valve div of Security Engrg Co, Whittier, Calif., a member of Dresser Industries, Inc, has been acquired by **Kerotest Mfg Co,** Pittsburgh valve manufacturer. A new manufacturing plant has been acquired at Slauson and Alcoa Ave, Los Angeles, where present line of Security cast- and forged-steel valves and Kerotest valves will be produced for Pacific Coast and western distribution. At the same time, formation of a new co, Kerotest Pacific Co, had been announced. This co is to be operated as a subsidiary of the parent Pittsburgh co, Kerotest Mfg Co, to serve Security valve and Kerotest customers throughout the western states. General sales offices will be at 3305 E Slauson Ave, Los Angeles. Officers of Kerotest Pacific Co are as follows: Edward G Mueller, president; Stanley J Roush, vice-president and general sales manager; Walter G Swaney, secretary-treasurer.

Frederick C Esser, formerly purchasing agent of Bryant Electric Co, a subsidiary of **Westinghouse Electric Corp,** has returned to Bloomfield, N. J., as purchasing agent of Westinghouse lamp div. T Addison Clohosey has been named purchasing consultant and Harry D Hanafus assistant purchasing agent of this div.

David M Salsbury has been appointed executive vice-president of **Westinghouse Electric Supply Co.** Mr. Salsbury succeeds Walter Williamson, who has retired.

R G LeTourneau, Inc, announces election of Stanley D Means to newly created position of domestic sales manager. Mr Means will have responsibility over all sales in U. S., Canada, Hawaii and Alaska. His duties will include management of eastern, central and western sales territories, and governmental sales, as well as continued personal supervision of industrial sales.

S B Applebaum, vice-president and director, H L Tiger, vice-president and director, and Norman E Brice, mechanical engineer, resigned from the **Permutit Co.** H L Bechner and A D Way have been appointed technical manager and chief mechanical engineer respectively. Mr Bechner will also serve as chairman of the engineering committee.

Messrs Applebaum, Brice and Tiger are organizing a new company under name of **Liquid Conditioning Corp** which will carry on a general business in field of water con-

Whatever combination of conditions your springs must fight...

CORROSION • RUST • HEAT • COLD • HIGH STRESS • FATIGUE

Whatever type of spring you need...

COMPRESSION • EXTENSION • TORSION • SPIRAL • FLAT • CLIP • RETAINER • GARTER • BANANA

Consider these alloys first...

MONEL® • "K" MONEL® • INCONEL® • "Z" NICKEL® • NICKEL

There is no need to put up any longer with repeated troubles that can be avoided by using INCO Nickel Alloy springs for corrosive conditions and elevated or sub-zero temperatures.

Now, rustless, high-strength springs can be made of five different INCO Nickel Alloys to withstand corrosive attack and temperatures up to 750°F. or even higher.

And they cost so much less than special alloy springs that it is practical to use them for any application where heat, corrosion or fatigue are causing you trouble with ordinary spring parts.

NICKEL (INCO TRADE MARK) ALLOYS

HERE'S A CHANCE TO GET RID OF THE SPRING PROBLEM THAT HAS BEEN BOTHERING YOU

Send for "ANALYZING THE SPRING PROBLEM." When you get this simplified worksheet, jot down the data about your spring problem and what you want in a spring. The information you supply, plus our service records and test data, will enable us to judge which material can be recommended for your particular service. Then, we will cooperate with your spring manufacturer to work out the answer to your problem. That is all you need to do. Write today for "ANALYZING THE SPRING PROBLEM."

THE INTERNATIONAL NICKEL COMPANY INC., 67 WALL STREET, NEW YORK 5, N. Y.

solved by Oakite

Quick Way to Clean Surface Condensers

REGULAR cleaning of surface condensers pays for itself in two ways. High vacuum is maintained. Operating efficiency is increased. Make this maintenance task easy on yourself, easy on your pocketbook . . . try the modern Oakite technique.

Plant-proved Oakite methods for removing sludge and other insulating deposits from steam side of tubes; for removing lime scale from water side are fast, effective. You will find Oakite degreasing and descaling solutions remove all deposits thoroughly, speedily. Normal vacuum is quickly restored. Equipment out-of-service time is reduced to a minimum.

Technical Data FREE!

A new 20-page Digest outlines methods for establishing significant savings on this and 70 similar maintenance cleaning jobs. Write for your FREE copy today. On your letterhead, please.

OAKITE PRODUCTS, INC.
23 Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* **CLEANING**
MATERIALS • METHODS • SERVICE

ditioning. Also, they will provide equipment and materials for conditioning other liquids. Present offices of the new company are at 423 W 126th St, New York City, and a new plant will be constructed at Linden, N. J.

Universal Lubricating Systems, Inc, announces election of Austin L Staley as president and William P Farrell as vice-president.

Golden-Anderson Valve Specialty Co moved from Fulton Bldg to Keenan Bldg, Pittsburgh 22, Pa.

Appointment of Robert A Rankin as sales manager of diesel engine div, **Chicago Pneumatic Tool Co,** was announced.

Name of Coaltoter Conveyor Co, 310 S Michigan Ave, Chicago, has been changed to **Material Movement Industries.**

Formation of a new sales organization to handle all sales activity of **Pennsylvania Flexible Metallic Tubing Co,** Philadelphia, was announced. The new organization will be known as Penflex Sales Co and will be headed by Howard L Boetsch. Home office of sales co will be at plant of parent firm, 72nd St and Powers Lane, Philadelphia. Sales activity of New Orleans branch of Pennsylvania Flexible Metallic Tubing Co has been taken over by offices in Houston, Tex. Paul H Lynch has been made sales manager of Houston office and A L Wimberley becomes assistant to Mr Lynch.

Manzel Brothers Co appoints Herbert H Roosa sales manager.

R M Wilson Jr has joined technical service section of development and research div of **International Nickel Co,** at New York, as a welding engineer.

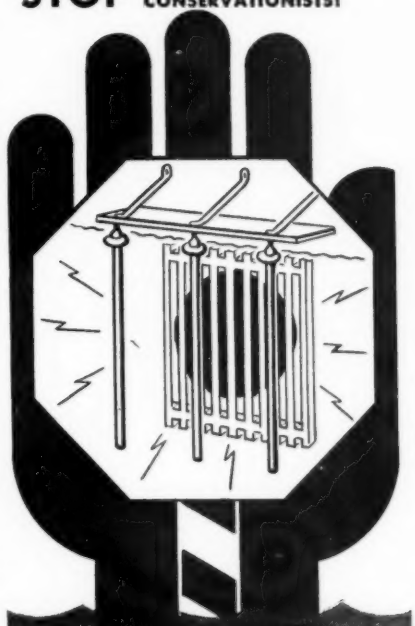
William A Mudge, assistant director of technical service of International Nickel Co's development and research div, at New York, has been elected chairman of New York chapter of **American Society for Metals,** to serve during the coming year, 1946-1947. Harold L Geiger, head of Chicago technical section of development and research div of International Nickel, has been elected chairman of Chicago chapter of American Society for Metals for the year beginning Sept, 1946.

Chester Mfg Co, which has been operated for past five years as a partnership, has incorporated and is now known as **Chester Hoist Co.** The officers are Hal F Wright, president; Mary T Wright, vice-president; Harry E Hill, secretary and treasurer.

Kieley & Mueller, Inc, announce appointment of Stentz Equipment Co, Tulsa, Okla., as sales representative for their lines of diaphragm motor valves, pressure regulators and liquid-level controls. Territory served by Stentz organization covers Okla., Kan. and Tex. panhandle. Ryder Equipment Co, St. Louis, Mo., were made representatives in Mo. and southern Ill.

Ward Keener has been elected to office of vice-president for employe relations of **B F Goodrich Co,** Akron, O. In this new capacity, Mr Keener heads a new div re-

STOP NEEDLESS DESTRUCTION OF FISH!
STOP HEAD LOSS . . . AT YOUR INTAKES!
STOP SCREEN MAINTENANCE WORRIES!
STOP CRITICISM . . . FROM CONSERVATIONISTS!



AN INVISIBLE BARRIER

YOUR ZONE of PROTECTION

Burkey Electric Fish Screens solve your fish control problems—cheaply, effectively, harmlessly. Electronic impulses keep fish of all sizes *safely* away from intakes or outlets. The electrode systems are custom-built for your particular intake—designed to permit a full head of water. No screen cleaning necessary.

Every Burkey installation is engineered to your problem regardless of size. Burkey Electric Fish Screens are thoroughly proven by years of service in condensing water intakes, hydroelectric plants, water systems and industrial pumping installations. Recommended by State Conservation Officials.

★ **SEND FOR LITERATURE AND QUOTATIONS**

ELECTRIC FISH SCREEN CO.
1130 N. Poinsettia Place • Hollywood 46, Calif

FOR EFFICIENT *Dust recovery*

SPECIFY BUELL'S exclusive... 6

"*Buell's Exclusive 6*" refers to the six design features which distinguish Buell (van Tongeren) Dust Recovery Systems from all other mechanical dust collectors.

These six mechanically-important features have made possible a three-point record of achievement in industrial dust recovery: (1) high operating efficiency (2) minimum cost of maintenance (3) long life. A record of *guarantees fulfilled*, of *virtually trouble-free service.*

"*Buell's Exclusive 6*" are briefly described in the paragraphs immediately below. In following sequential advertisements each feature will be separately illustrated and described in interesting detail.

1 The "Shave-Off" . . . The patented van Tongeren principle, exclusive with Buell. Utilizes the "double eddy" current, establishing a highly efficient collection force.

2 Large Diameters . . . Permit use of extra thick metal. Afford large dust outlets, prevent clogging. Reduce abrasion.

3 Extra-Sturdy Construction . . . Rolled and welded, one piece construction; hoppers braced with 3" channels to withstand vibration.

4 Correct Hopper Design . . . Plays a most important, often disregarded, part in dust collection efficiency. Dust disposal facility must be anticipated in the initial overall design.

5 Split-Duct Manifolding . . . A prime factor in efficient distribution of the dust load. Buell's manifolding method has flexibility, discharging gases from any side or end.

6 Inner Welds Ground Smooth . . . Proper finishing of inner welds effects operating efficiency, reduces erosion, ensures longer life.

Buell's book—"The van Tongeren System of Industrial Dust Recovery"—illustrates and explains the patented van Tongeren principle and its many applications to industry.

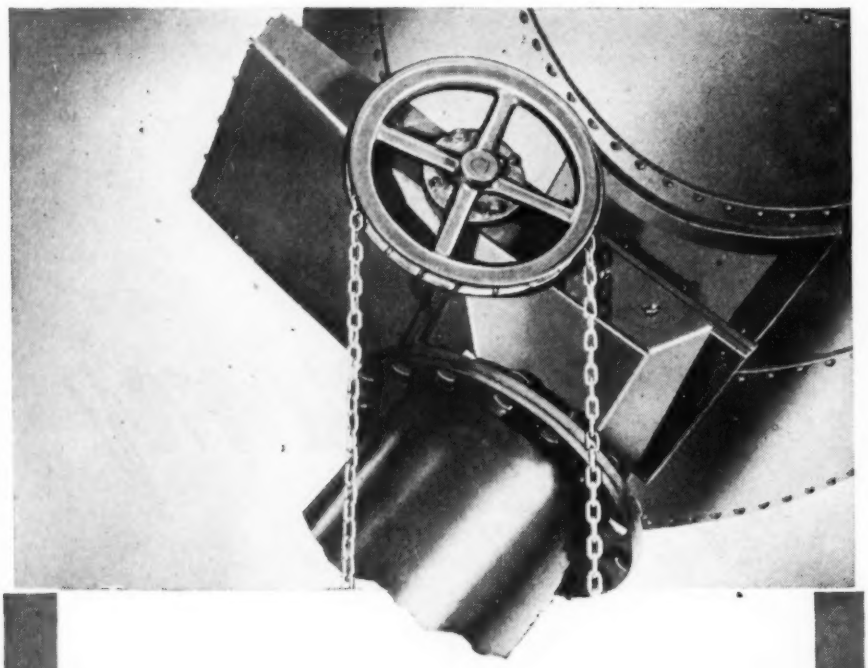
buell
DUST RECOVERY SYSTEMS

BUELL ENGINEERING COMPANY, INC.

10 Cedar Street, New York 5, N. Y.

Sales Representatives in Principal Cities

DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"



The gate can't bind in S. E. Co. Coal Valves

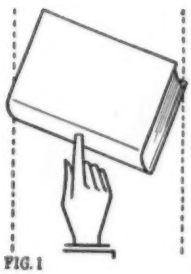


FIG. 1

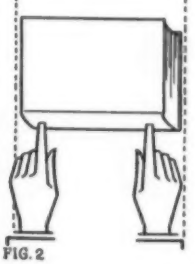


FIG. 2

Try this practical demonstration . . . see *why* for yourself!

The gate in a S. E. Co. Coal Valve can't stick because it is closed and opened by twin racks and pinions, each side advancing the gate exactly the same distance. Thus the gate moves open or shut easily and smoothly. To see the proof of the effectiveness of this method, place a book on your desk and try to push it away with one finger, as shown in Fig. 1, without letting the book turn. Now place both index fingers against the book, as in Fig. 2, and push, with both fingers moving at the same speed. That's all—and that's one of the reasons a S. E. Co. Coal Valve won't bind! *Write for bulletins* on the Coal Valve and other S. E. Co. Products. Address Stock Engineering Co., 715 Hanna Bldg., Cleveland 15, Ohio.

STOCK ENGINEERING CO.

★ CONICAL Non-Segregating Coal Distributors ★

S.E.CO. Coal Valves and Coal Scales

sponsible for all employe relations activities throughout the organization. B A Evans has been named manager of wheel and brake manufacturing dept. The co recently purchased the airplane wheel and brake div of Hayes Industries, Inc, where manufacturing operations are being conducted at present. Appointment of R J Keller as technical manager of wheel and brake manufacturing dept also was announced.

Hammel-Dahl Co appoints Wayne B Farley district manager of their Pittsburgh office.

C J Merritt joins **Consolidated Industries, Inc.** He will be in charge of research and design on gas heating equipment.

Foote Bros Gear & Machine Corp announces appointment of Charles U S Grant to Cleveland office.

C C McDermond has been made representative of welding fittings div of **Tube Turns, Inc,** in Venezuela and Columbia, S. A. Mr McDermond and his assistant, C T McCoy, made their headquarters in Apartado No. 331, Maracaibo, Venezuela.

H K Porter Co and subsidiaries announce opening of a new district office in Paul Brown Bldg, St. Louis, Mo. R E Nelson will be in charge of sales for Porter process equipment, Devine refinery and process equipment, Quimby pumps and Porter locomotives.

Malcolm P Ferguson was elected president of **Bendix Aviation Corp,** succeeding Ernest R Breech who has resigned to become executive vice-president and a director of Ford Motor Co.

Gulf Engrg Co, 916 S Peters St, New Orleans, La., has been appointed to handle account of **Hungerford & Terry, Inc.** Ralph M Westcott Co, 1700 S Main St, Los Angeles, Calif., has been made southern Calif. sales representative.

Freedom-Valvoline Oil Co announces merger of Freedom Oil Co, Galena Oil Corp and Valvoline Oil Co. William G Bechman is chairman of board of directors; Gus P Doll, vice-chairman of board of directors and executive vice-president; and Earle M Craig, president.

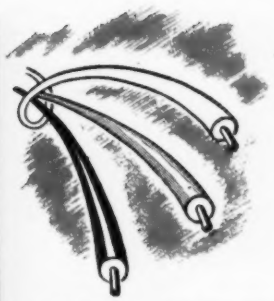
Appointment of S H Bivins as manager of western regional industrial sales has been announced by **Detrex Corp.** His headquarters will be in Chicago.

U. S. Radiator Corp elected Wesley J Peoples chairman of board of directors and acting president. L Gillespie Erskine continues as a director and consultant to co. Carroll M Baumgardner was elected executive vice-president. All other officers were re-elected.

Appointment of Robert H Davies to head a new engineering div which will combine the previously separate functions of product development, product engineering and technical service is announced by **Parker**

FLAMENOL CABLE

for wiring that's EASY TO IDENTIFY — HARD TO HURT



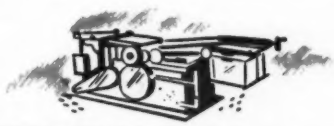
Electric circuits on machines, panelboards, control devices and the like are easily traced and identified when wired with Flamenol Cable. The smooth, impervious insulation of Flamenol *stays* bright and clean. Seven colors provide for permanent coding of complex circuits.

Once wired with Flamenol, electric circuits are well protected for the full life-span of the machine. All the usual causes of insulation damage have little if any effect on the insulation of Flamenol, as these actual cases show:

OIL WON'T HURT IT—In a chemical process plant, leads to oil-immersed motor controls were a constant source of trouble, until rewired with Flamenol. They've never given trouble since.

MILD ACIDS AND ALKALIES WON'T HURT IT—Used to wire a battery-charging set-up, Flamenol didn't fail despite "dunking" with electrolyte. In paper-mill wiring, it stood up against alkalies.

SOLVENTS WON'T HURT IT—Flamenol ended wiring troubles on printing presses where inks splashed on the wiring.



MOISTURE WON'T HURT IT—After 7 years underground in damp soil, Flamenol insulation was still impervious.

AGE WON'T HURT IT—In a seven-year test under Florida sunlight, the insulation on Flamenol cable showed no signs of deterioration.

ANOTHER G-E ACHIEVEMENT RESULTING FROM "FULL-RANGE" RESEARCH

Long before the rubber shortage, G.E. had been seeking a "better-than-rubber" insulation for low-voltage wire and cable; an insulation that would be slow to age, hard to burn, and able to resist acids, oils, water, and alkalies. Soon, chemists in the G-E laboratories produced such an insulation from plasticized polyvinyl chloride. G-E process engineers then took the new insulation, and prior to 1936 had solved the problem of its application to a conductor on a practical basis. The result was Flamenol, the first wire and cable to be insulated with long-lived, tough, plasticized polyvinyl chloride—another G-E first. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

502-58-1200

10 REASONS WHY
FLEXO JOINTS
WILL PROVE DEPENDABLE
IN YOUR PLANT

- Gives a Full Range of Easy Movements
- Has The Flexibility of Hose
- Has The Strength of Pipe
- Unrestricted Flow of Fluid at all Times
- Exceptionally Low Maintenance Cost
- Nominal First Cost
- Fully Protected From Dirt
- Made of 4 Simple Parts
- Dependable Service
- Simple To Install

"H" "F" "B" "A"

Installation of Flexo Joints wherever a swing joint is required will prove a wise and economical move because they have been tried and tested throughout the years and have proven their durability and efficiency in many plants.

Unusually low maintenance cost plus no complicated parts to get out of order make them economical to use.

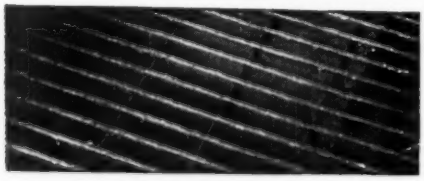
Ruggedly made for long, hard service. Pipe sizes range from ¼ inch to 3 inches.

Send for illustrated literature and data

FLEXO SUPPLY COMPANY Inc., 4224 OLIVE ST. St. Louis (18),

In Canada: S. A. ARMSTRONG 115 Dupont St., Toronto (5), Ontario

SPECIFY OPEN STEEL FLOORING
for maximum light and ventilation!



Hendrick Mitco open steel flooring has rectangular openings that afford maximum light and ventilation —a 90% open area! Mitco performance and service life always measure up to expectations because Mitco's square edge bars are formed into an integral unit and provide a safe, non-slipping, level walking surface. It has no bolts, nuts or rivets to collect dirt and obstruct light. If you will send details of your area to be covered, indicating size, type and location of supports, Hendricks will prepare a Mitco recommendation.

HENDRICK
Manufacturing Company

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Amorgrids.

46 DUNDAFF STREET, CARBONDALE, PENNA.

Sales Offices In Principal Cities

Appliance Co. Emmett C Hartley becomes manager of a new special products div which has been established to handle manufacture and sale of rubber and plastic products. Leland H Schmohl will continue direction of product development in new engineering div as chief design engineer. Henry M Reese has been made special field sales application engineer with headquarters in Cleveland.

American Well Works appoints Henry H Teplitz Advertising Agency, Chicago, as advertising counsel.

Scovill Mfg Co announces appointment of G K Thornton as advertising manager.

Charles E Klaus has been made **Allen-Bradley** representative for Portland, Ore., area, taking over territory formerly served by Garland-Affolter Engrg Corp. Mr Klaus is located at 1233 N W 12th Ave, Portland, Oregon.

Farris Engrg Co announces that their Detroit representative, DuBois-Webb Co, has recently added Howard Kalbfleisch to their sales engineering staff. He will assist in engineering sales and service of Farris safety and relief valves in Mich. territory.

Walter P Berg has been appointed general manager of machinery div of **Dravo Corp.** Mr Berg assumes duties of W K Fitch, who became board chairman.

Ampco Metal, Inc, announces transfer of Gordon E Brown to Hartford, Conn., district as field engineer.

Jerry Sabin has been made director of advertising for all divisions and subsidiaries of **Colorado Fuel & Iron Corp.** He will continue to maintain headquarters in Denver. Matthew R Roose becomes export manager. Mr Roose will continue to be located at 500 Fifth Ave, New York, N. Y. In addition to Wickwire Spencer Steel Div, other parts of Colorado Fuel & Iron Corp which will be under his direction are the Colorado Div and California Wire Cloth Corp.

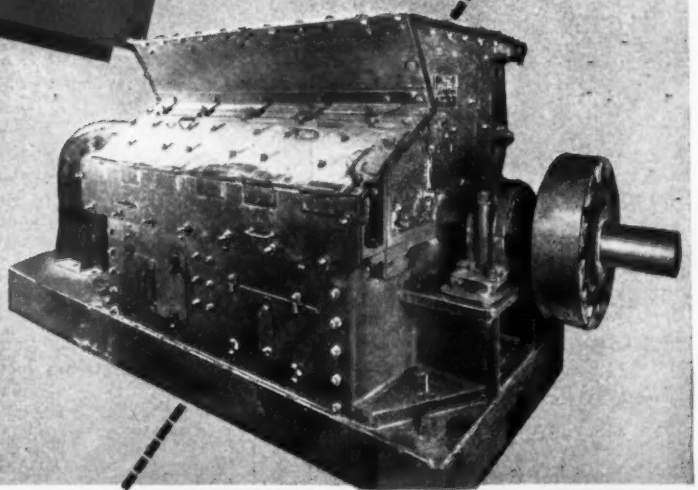
Ladish Drop Forge Co announces appointment of C R Standen as advertising manager.

Cutler-Hammer, Inc, announces opening of a new office in Rockford, Ill., at 1404 N Main St. Office will be in charge of G I Wolff. R E Ford will be resident sales engineer.

Oscar B Schier II has been appointed secretary to standing committee on professional divisions of **American Society of Mechanical Engineers.**

Titus G LeClair, chief staff engineer, Commonwealth Edison Co., has been elected president of **Western Society of Engineers** for the year 1946-1947. William V Kahler, general manager, Illinois Bell Telephone Co, becomes first vice-president; Verne O McClurg, consulting engineer, firm of Mundie-Jensen-McClurg, becomes second vice-president; M W Casad, plant extension engineer, Illinois Bell Telephone

POWER from WASTE WOOD



FOR EFFICIENT POWER — — —
WASTE WOOD MUST BE HOGGED

Since 1938, the Jeffrey Hog has been used to make an economical and highly efficient fuel in the power plant designed by Sill and Warrington, Consulting Engineers of Boston for the Heywood-Wakefield Company of Gardner, Massachusetts. We will be glad to tell you more about this job.

THE JEFFREY MANUFACTURING COMPANY

932-99 North Fourth St., Columbus 16, Ohio

ESTABLISHED 1877

Jm

Baltimore 1 Buffalo 2 Cleveland 13 Horton Milwaukee 11 Pittsburgh 22
Birmingham 2 Chicago 1 Denver 2 Houston 5 New York 7 St. Louis 3
Salt Lake City 1

HERCULES
SEAMLESS COPPER
FLOATS
HERCULES

GUARANTEED
TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

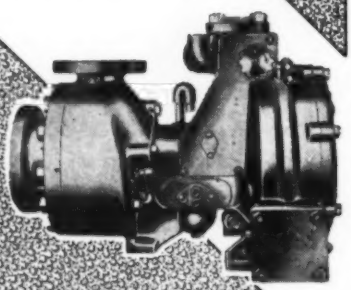
Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service. Insure carefree maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

COFFIN TURBO PUMPS

FOR BOILER FEED AND GENERAL HIGH PRESSURE SERVICE



THE J. S. COFFIN, JR., CO.
ENGLEWOOD, NEW JERSEY

Co, was re-elected treasurer; Leigh S Keith remains as secretary. New members of society's board of directors are J de N Macomb, assistant to vice-president, Inland Steel Co, and Henry Penn, district engineer, American Institute of Steel Construction.

Midwest Research Institute, Kansas City, Mo., has announced formation of its engineering mechanics section. Previously, work in this field was done under supervision of applied physics section. Martin Goland has been appointed chairman of the new section. Clayton O Dohrenwend will serve as research consultant and senior scientist.

Georgia Tech has organized the **Georgia Tech Research Institute** as successor to earlier Industrial Development Council because of increased volume of industrial research and development conducted at the school. It is a non-profit organization with Fuller E Calloway Jr, chairman; Blake R Van Leer, president of Georgia Tech, vice-chairman; Harry L Baker Jr, president; Gerald A Rosselot, director of research and secretary; and Cherry L Emerson, treasurer.

Bituminous Coal Research, Inc, has made following appointments to BCR technical advisory board: C R Mabley Jr, John Mitchell and Charles J Surdy.

Public Service Co of N. H. has promoted Carroll F Kelley to position of domestic sales manager, with offices in Manchester, N. H.

R C Cox has been made manager of newly created publicity dept of **Philadelphia Electric Co.**

Alois Hoefle returns to **Toledo Edison Co,** after military service, as superintendent of company's system operation.

Thomas M Burton has been appointed chief engineer of steam stations, **Boston Edison Co,** succeeding the late Richard Brown. C R Irving and H E Stickle have been named assistants to chief engineer of steam stations.

Homer M Pace, Charleston, vice-president of South Carolina Power Co, was elected president of **Southern Association of Science and Industry** recently.

Geo H Gibson Co, industrial advertising agency of New York City, has added Harry Bauer, production manager, and J Doran Williams, art director, to its staff.

OBITUARIES

Weston M Fulton, 75, inventor of a device for thermostatic control of temperatures and head of Fulton Sylphon Mfg Co until 1930, died in Knoxville, Tenn., on May 16.

Thomas P Boyd, 47, treasurer of Pump Equipment & Engrg Co, Cambridge, Mass., died at Malden, Mass., on May 23.

Charles A Hall, superintendent of Cabot hydroelectric station of Western Massachusetts Electric Co, Montague City, died recently.

★

FREEDOM From Scale

Is the Right of Your Boiler. As you reduce scale You decrease fuel — And Increase Power. Here's How—

SAND-BANUM

"The Entirely Different Boiler and Engine Treatment"

Automatically and in Absolute Safety to Personnel and Equipment, Removes and Prevents Boiler Scale and Corrosion.

Generally speaking, the conductivity of boiler scale is about 1/48 that of iron. 1/32 of an inch of scale is estimated to waste 140 lbs. of fuel per ton, or 10% surplus fuel consumption.

Sand-Banum makes water analyses unnecessary. It is a pure vegetable compound of tropical resins. Remains constant under application of heat, and unfailingly reaches the most inaccessible parts.

GIVE YOUR BOILER

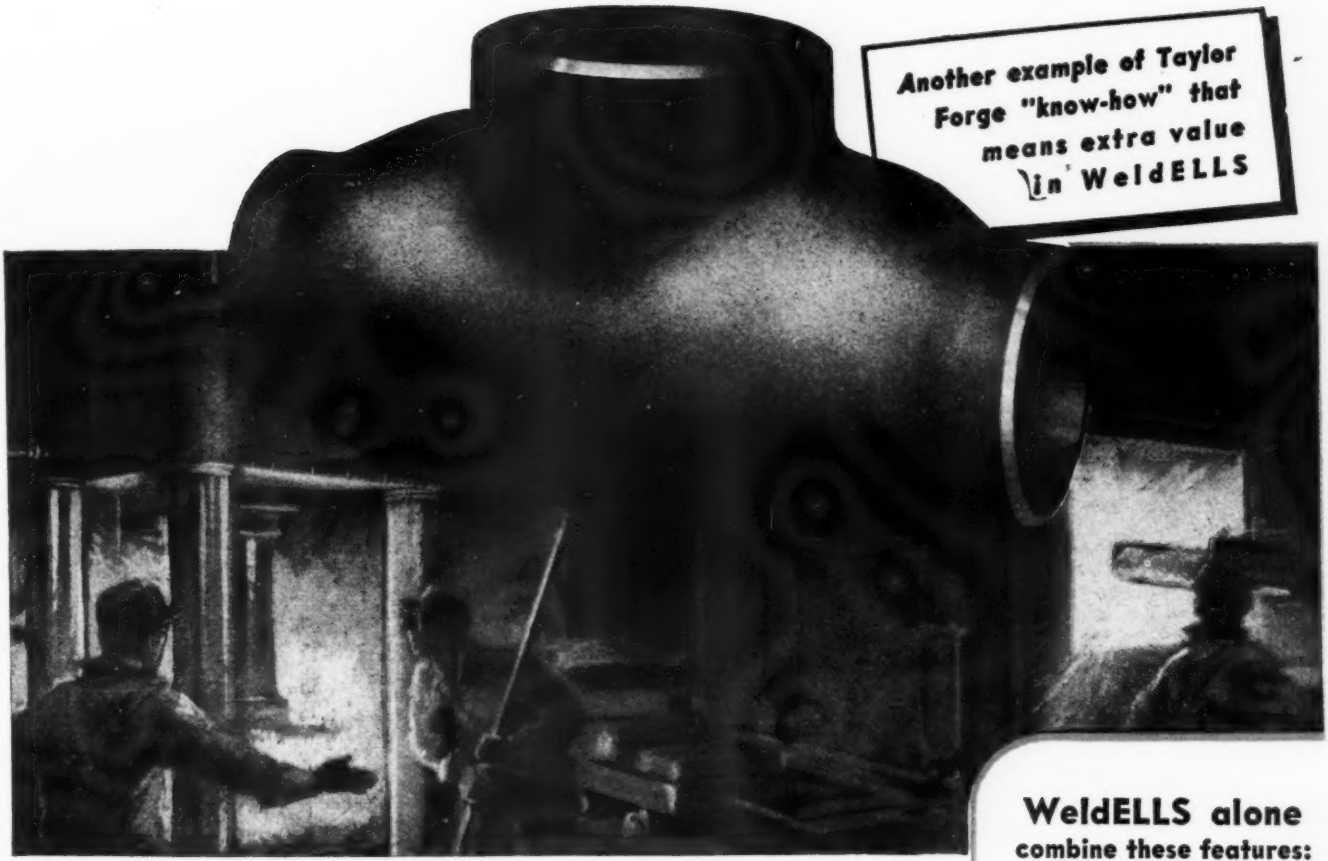
This New Freedom from scale and corrosion. Get more power from less fuel, and lessen shut-downs regardless of water or operating conditions.

Write for Data Today

AMERICAN SAND-BANUM COMPANY, Inc.
9 Rockefeller Plaza, New York 20, N. Y.

Stocks carried by
WESTERN SAND-BANUM COMPANY
Houston, Texas
and at other convenient points including leading supply houses

Export Representatives
PETROLEUM MACHINERY CORP.
30 Rockefeller Plaza New York 20, N. Y.



Another example of Taylor Forge "know-how" that means extra value in WeldELLS

Rare specimen in Welding Tees—

● *When you think of a reducing tee you always picture it as reducing in the branch. But this one, for the peculiar purpose it serves, had to be made the other way around. It's a seamless, carbon-moly forging, five inches in the run with a seven-inch branch—an "increasing" tee, so to speak; one more example of those kinks that are found so abundantly in the Taylor Forge bag of tricks.*

The "know-how" acquired during many years of performing these special—often extremely difficult—manufacturing operations, has a mighty important bearing on our standard line of WeldELLS, Welding Tees and other Taylor Forge Welding Fittings.

It means that in developing WeldELLS we did not have to ask what kind of fitting is easiest to manufacture. Instead we asked what comprises the ideal fitting, and then, with every special facility and process at our command, made that conception a reality.

That is why WeldELLS have tangents . . . why they have extra reinforcement where service stresses are greatest . . . why they have such extremely accurate dimensions . . . why they have the features listed opposite . . . why, in short,

WeldELLS *have everything*

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

ADACAST

A castable refractory that pours like concrete . . . so easy to use . . . economical, efficient . . . that unskilled plant labor can produce fine results.

Excellent for casting furnace door linings, burner blocks, etc. Don't wait six weeks or longer for special shapes — make them yourself.

BOTFIELD REFRACTORIES CO.

784 S. Swanson St., Philadelphia 47, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

SCHERR

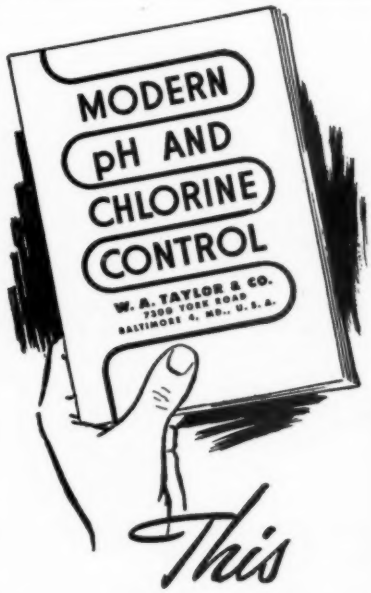
PRECISION INSTRUMENTS
For Close Reading
HAND TACHOMETERS

Measure rpm without timing or calculation while held against end of rotating shaft. Any variation in speed caused by belt slipping, overload, etc., is instantly noted. Also have disc for measuring surface speeds in feet per min. Made for speeds from 30 to 12000 changing speed range by new rotating shift mechanism. Other types to 48,000 rpm. Write for details.

SPEED INDICATORS

Gives direct readings in rpm in a test requiring only 6 seconds. Needle remains at reading until released by pressure of button. Also measures linear speeds using disc attachment. Two types, ranges to 20,000 rpm. Full data on this and other Scherr speed measuring instruments on request.

GEO. SCHERR CO., Inc.
196-A Lafayette St.
New York 12, N. Y.

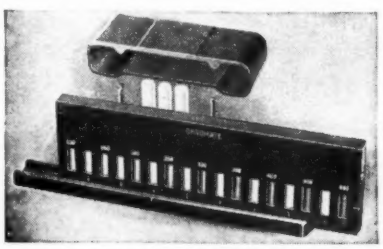


HANDY REFERENCE BOOK

IS FREE...

You'll find it as helpful to you as it has been to thousands of other power plant men. Its 88 pages are packed with authoritative information . . . theoretical and practical. It contains a simple explanation of the meaning of pH control, a special discussion on the importance of control of pH, phosphates, silica and nitrates in boiler water; precautions to be observed in making determinations and descriptions of Taylor Comparators for boiler water control.

Get it . . . read it . . . and benefit! No obligation, of course. Your dealer has a copy for you . . . or write direct.



TAYLOR CHROMATE SLIDE COMPARATOR

for controlling calcium and sodium brines

Designed to show you, by direct color comparison, the chromate concentration. Simple and easy to use . . . accurate because Liquid Color Standards CARRY AN UNLIMITED GUARANTEE AGAINST FADING. Two Chromate Comparators are available; one for refrigerating brines and the other for air conditioning. Both slides work on Taylor pH and phosphate bases.

Chromate Comparator.....$15.25
In Wooden Carrying Case.....$20.25
Slide only with funnel and filter paper.....$8.00

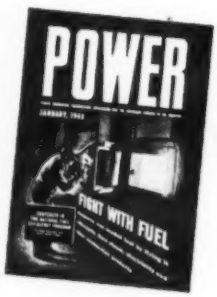
Details of this and other Taylor Comparators are contained in free reference book offered above. See your dealer or write direct.

W. A. TAYLOR AND CO.
YORK & ROGERS FORGE RDS. • BALTO. 4, MD.

To Get the Answers on Questions About . . . .

Mechanical Transmission	Electricity
Boilers & Heating	Oils and Lubrication
Pumps and Compressors	Refrigeration
Diesel and Gas Engines	Fuels and Furnaces
Steam Turbines, Condensers	Steam Engines
Valves, Piping and Fittings	Meters and Instruments

. . . READ



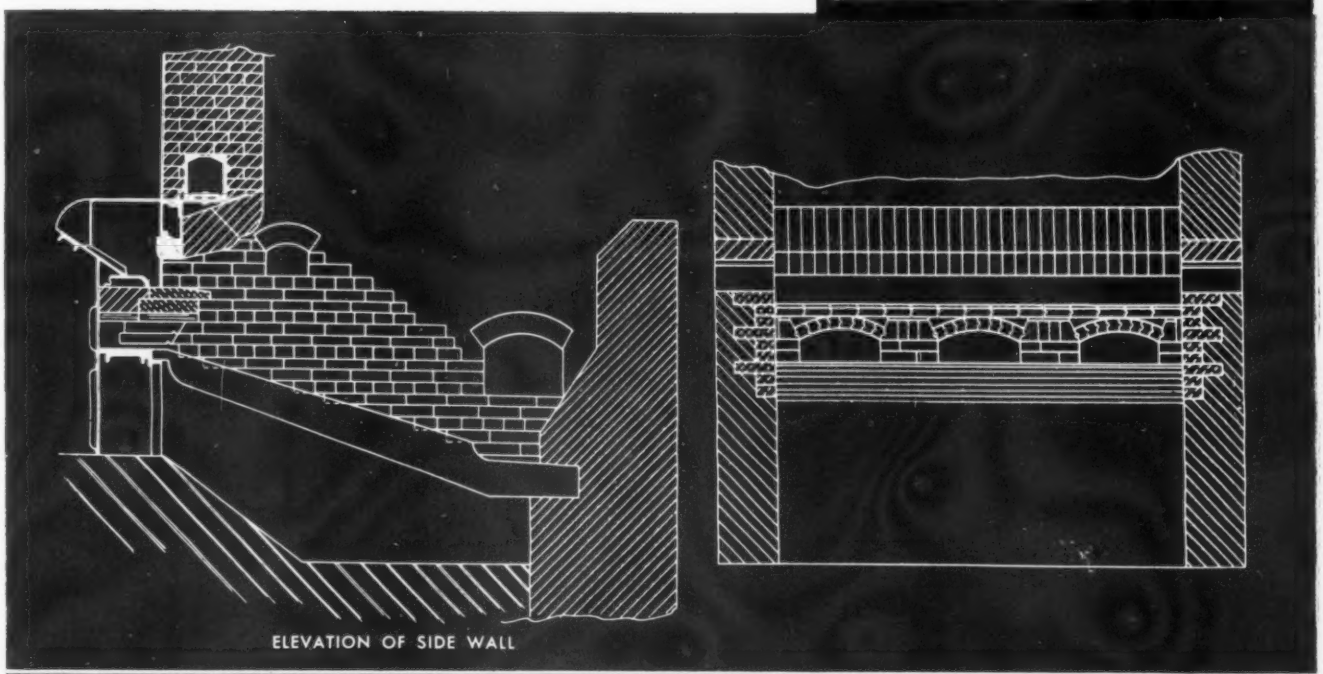
REGULARLY

Covering the Generation, Transmission and Application of ALL the Power Services

330 WEST 42ND STREET • NEW YORK 18, N. Y.

WALL BRICK DATA

PERFECTION heavy duty STOKER



ELEVATION OF SIDE WALL

Because it costs less to get more steam

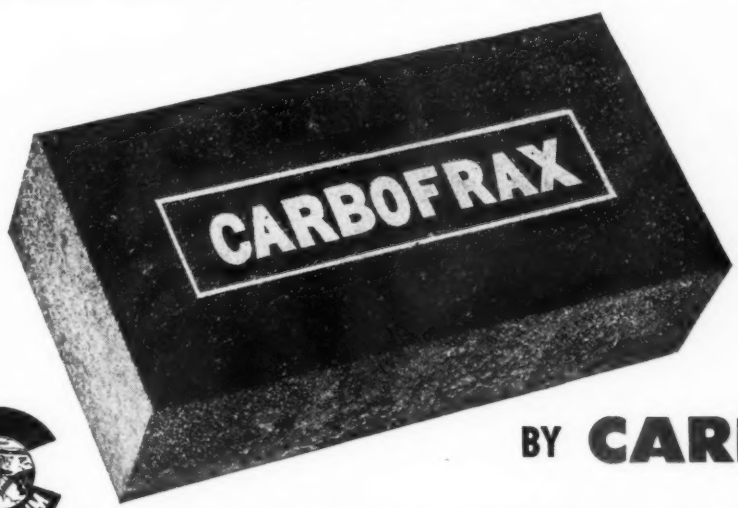
More and cheaper steam is assured by the CARBOFRAX silicon carbide brick setting designed for use with the Perfection heavy duty stoker shown here. Of course, the actual height of the lining may vary with operating conditions . . . but there is no question of increased efficiency and economy.

Here is why.

Clogging, heat consuming and space taking clinkers do not cling to the hard surface of CARBOFRAX brick. Even at extremely high temperatures, these brick do not provide an anchorage because they do not soften. The entire grate area remains free for more efficient combustion. A cleaner, more active fire means savings in fuel cost.

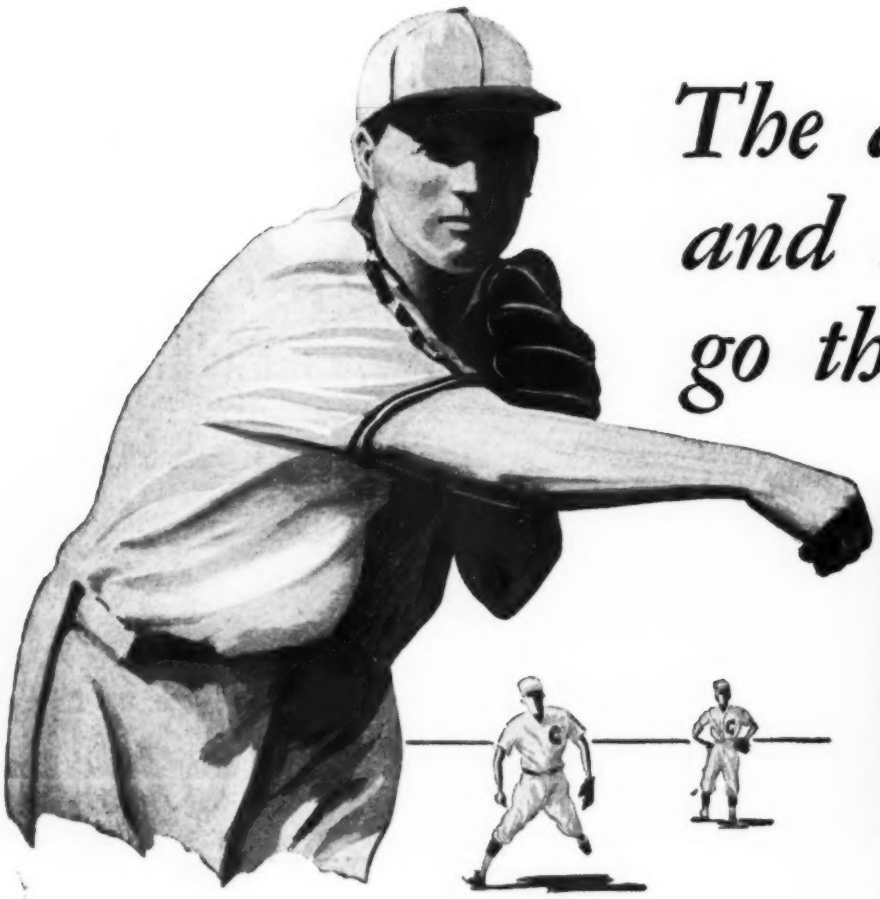
Steam production is further increased by continuous extended life from the CARBOFRAX brickwork. Reports of 8 to 10 years—even longer—on-the-line service are on record. In comparison with ordinary refractory installations, outages for repairs are hardly worth mentioning. The resultant drop in both labor and material costs alone is worth looking into.

As a matter of fact, you will find it well worthwhile to make a complete investigation of all the advantages of CARBOFRAX settings. It's easy to get complete information on how their elevated refractoriness, great mechanical strength at high temperatures and outstanding resistance to both mechanical and flame abrasion can improve your operation. Simply ask for your copy of an illustrated technical booklet "CARBOFRAX in Boiler Furnaces." Send in your request to Dept. G-76, The Carborundum Company, Refractories Division, Perth Amboy, N. J.

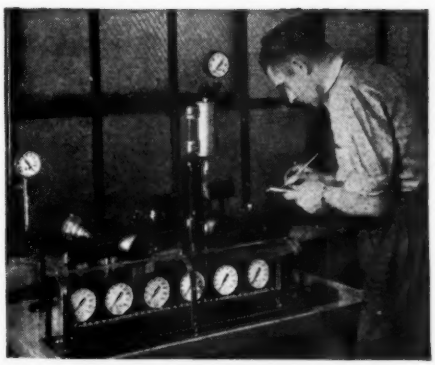


BY CARBORUNDUM
TRADE MARK

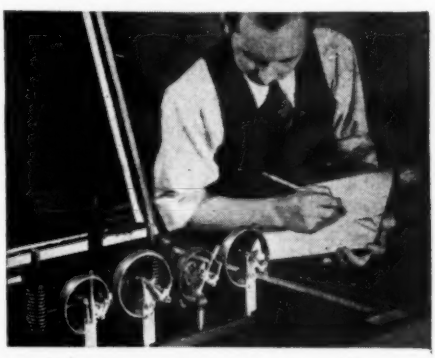
"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company



The accuracy and stamina to go the route—



Here gauges are tested under rapidly and violently pulsating pressure . . . a test that has guided many improvements in materials, design and construction.

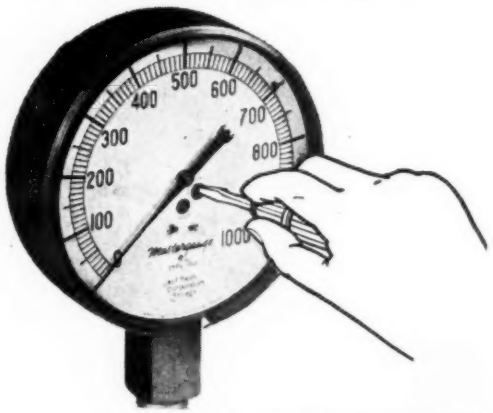


In this test, representative operating units from each production group are subjected to brutal vibration—tougher treatment than they will ever receive in service.

Few pitchers have ever attained perfection in both departments—accuracy *and* stamina—and this is equally true of pressure gauges. It is comparatively easy to put either of these qualities in a gauge—extremely difficult to make a gauge that is *both* accurate *and* rugged enough to "go the route" year after year on the job.

If there is one thing, more than any other, that distinguishes Marsh Gauges, it is the remarkable degree with which this combination of accuracy and stamina has been achieved in their construction. Every detail contributes stamina and the lasting accuracy it assures . . . the better bourdon tubes . . . the precise but strong movement protected from external shocks by Marsh "Unit Construction" . . . the sturdier gearing and linkage . . . and many other refinements.

Tests like those illustrated here are constantly made to prove the stamina of Marsh Gauges. Make no mistake about it: The accuracy of Marsh Gauges is not the transient kind!



Marsh alone has the "Recalibrator"—quickest and best way to correct a pressure gauge that has been knocked out of adjustment.

JAS. P. MARSH CORPORATION, 2075 Southport Avenue, Chicago 14, Ill.
Export Department: 155 East 44th Street, New York 17, New York

MARSH GAUGES

"THE STANDARD OF ACCURACY"

IMPRESSIVE FIGURES!

SINCE PEARL HARBOR

(Advertisement printed December, 1941)

STILL MORE IMPRESSIVE TODAY!
4 VERY IMPRESSIVE FACTS
18,221,000 lb. per hr. Steam Generated
1,102,500 K.W. per hr. Capacity
900°F. to 950°F. Temperature Conditions
720 to 2200 lb. Pressure Range
KELLOGG

35,541,500 lb. per hr.
STEAM GENERATED
18,221,000 lb. per hr. in 1941

2,355,000 k.w. per hr.
CAPACITY High Pressure Units Only
1,102,500 K.W. per hr. in 1941

900°F. to 1000°F.
TEMPERATURE CONDITIONS
900°F. to 950°F. Temperature Conditions in 1941

650 to 2200 lb.
PRESSURE RANGE
720 to 2200 lb. Pressure Range in 1941

These figures show the confidence placed by Consulting Engineers, Central Station and Industrial Power Plant Engineers, in Kellogg's ability to design, fabricate and erect piping installations, which perform as required, under the most advanced techniques of pressure and temperature.

While the figures show only high pressure installations, The Kellogg Company has also prefabricated and erected many piping jobs for lower pressures.

KELLOGG

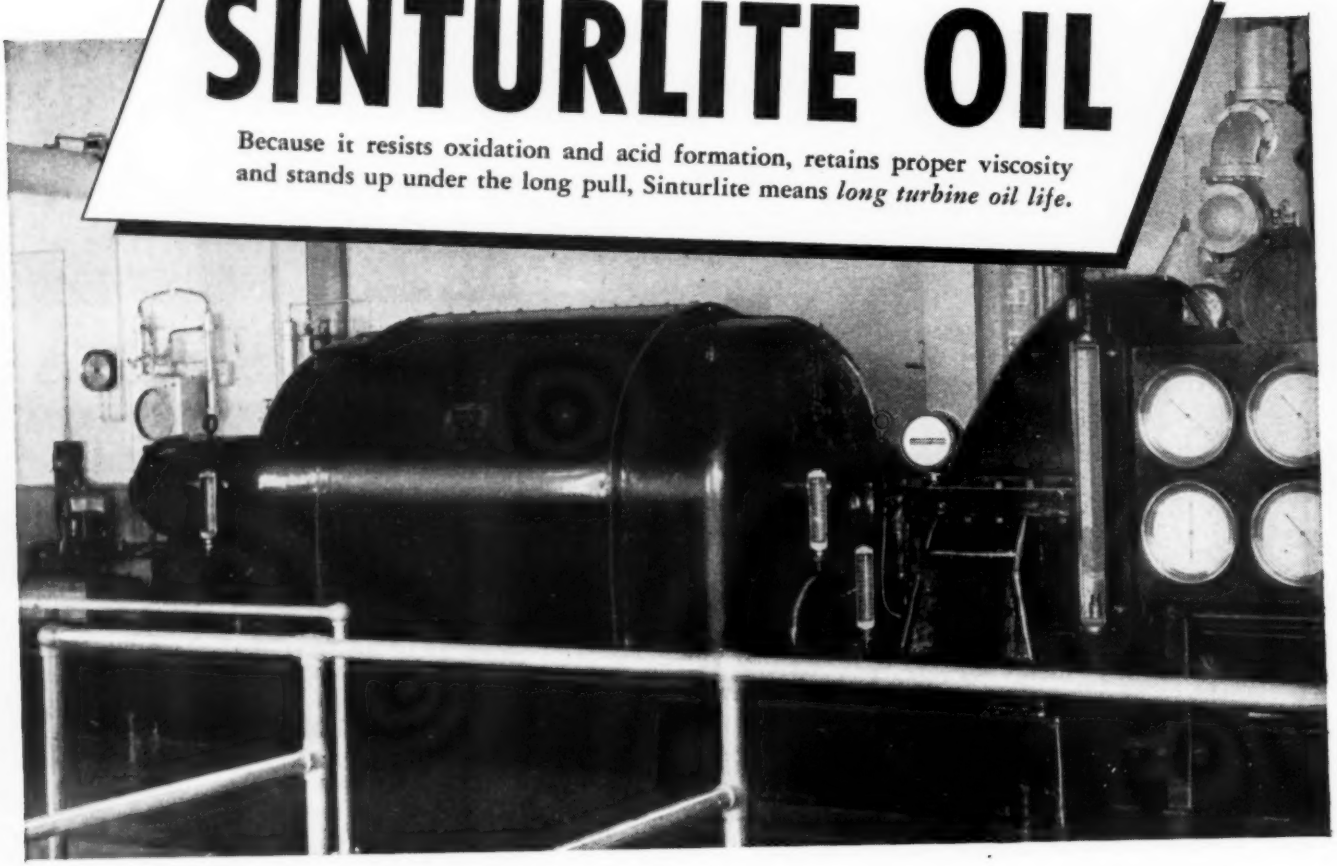
"Masterflex" Prefabricated Piping Systems · **"Masterweld"** pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · **JUIK Processes** for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY · JERSEY CITY, NEW JERSEY · 225 BROADWAY, NEW YORK 7, N. Y.
REPRESENTATIVES
LOS ANGELES: 609 SOUTH GRAND · HOUSTON 2, TEXAS: 402 ESPERSON BLDG. · TULSA: PHILTOWER BLDG.

For L-O-N-G-E-R TURBINE OIL LIFE *in the grueling grind*

SINTURLITE OIL

Because it resists oxidation and acid formation, retains proper viscosity and stands up under the long pull, Sinturlite means *long turbine oil life.*



HIGH SPEED turbines . . . operated continuously, day and night, month in and month out, meet a grueling grind. For proper lubrication, turbine oil must be constant in quality, capable of extended life. Sinturlite is made specially to stand up under all conditions in this long pull.

Non-foaming, non-corrosive Sinturlite provides lubrication that offers protection against expensive shutdown with interrupted power supply. Try Sinturlite for turbine lubrication problems.

SINCLAIR INDUSTRIAL OILS

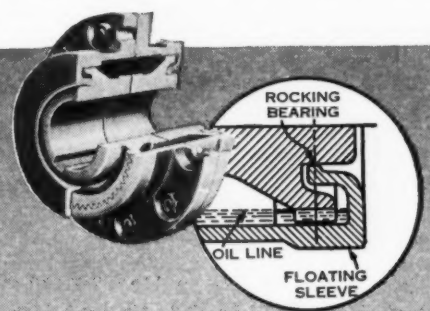
FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

23 YEARS ON A PUNISHING JOB WITH NO DELAYS—NO EXPENSE

Machinery around a cement plant generally takes an unusual beating, which makes this story of Fast's Coupling service of added significance. In 1923, a plant of a leading Portland cement company installed a No. 5 Fast's Coupling, connecting a fan for a waste heat boiler to a 160 HP, 510 rpm. motor. There is generally a mid-winter shut-down of from two to three months, but otherwise, operation of the equipment has been continuous. According to the Chief Engineer of all plants, and the Superintendent of the plant where this coupling is serving, the Fast's Coupling has never caused any interruptions to service, or any expense.

There are a total of 72 Fast's Couplings installed in the various plants of this company. Of these, 46 have been in use 20 years or more, 14 have served for 15 years, and 7 for more than 10 years.

When you are looking for dependable, trouble-free couplings, records like this provide the safest, most dependable guide an engineer could want. Ask for a catalog, listing types and sizes. Bartlett Hayward Division, Koppers Company, Inc., Baltimore 3, Md.



Here you see the features that give Fast's Couplings their remarkable dependability. All parts are protected from wear by a positive film of oil. Oil purity is guarded by rocking bearings, located in the one position where they maintain a positive metal-to-metal seal. There are no perishable parts in "Fast's."

a **KOPPERS** *Product*

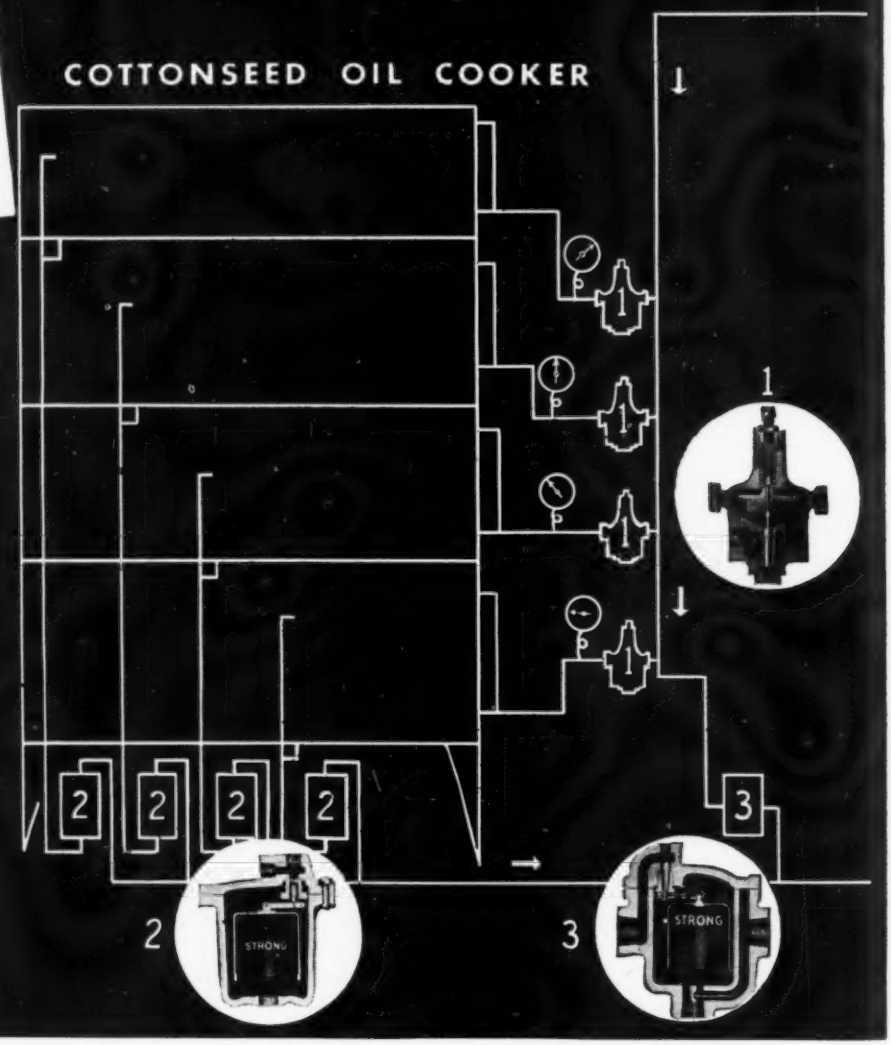
Double Problem in Steam

1 Control and variation of temperatures in four steam sections.

2 Correct drainage to insure maintenance of cooking temperatures.

HERE'S STRONG'S *Suggestion:*

1. Since temperature varies directly with steam pressure install Strong's variable pressure reducing valves (Type K with Anum-Metl disc and seat and integral strainer) on inlets of each section. Pressure gauges in reduced side of line provide easy visual control, eliminating maintenance of temperature regulator bulbs.
2. Use Strong's Series 80 inverted bucket traps with Anum-Metl valves and seats to drain each section. Insure positive drainage and uniform cooking of meats.
3. Small Strong series 70 inverted bucket trap with Anum-Metl valve and seat drains main header, insuring a constant supply of live steam at each reducing valve.



Time-temperature processes depend on both!

Cottonseed cookers, in common with all time-temperature steam processes, require both accurate pressure control and complete, automatic condensate removal. In this case, bright, high-quality oils depend upon how accurately equipment operates.

Knowing the problems involved, and having the steam specialties needed to solve them, Strong steam engineers can give unbiased, practical recommendations that insure satisfactory operation of your time-temperature processes. This calls for close attention to drainage equipment to fit the variables in each installation, determine peak loads, time required to reach temperature, etc.

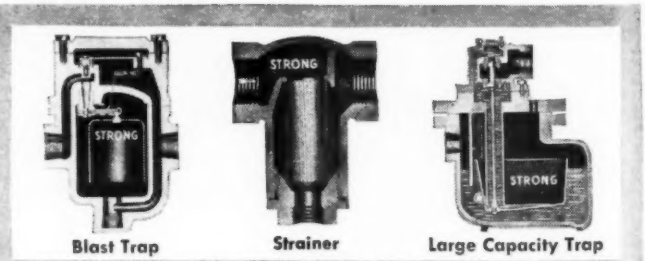
For any trap need, open or inverted bucket, float, float and thermostatic—in cast or semi-steel, forged or welded construction—call on

STRONG, CARLISLE & HAMMOND CO., Cleveland 13, O.

OTHER ANUM-METL Reg. Trade Mark

STRONG

STEAM SPECIALTIES



Blast Trap | Strainer | Large Capacity Trap

WHAT I WANT IS ACTION!

"Hang on to your nerves, boss. Armstrong's agreed to do it—but I sure hate to ask anybody to do a heat insulation job that fast."

"Why? That's their business, isn't it?"

"Sure—but it isn't their fault we didn't get the piping in earlier."

"What's the matter, Pete—you getting soft all of a sudden? The Production Department gave us just 72 hours to get that equipment operating and you're worrying about the Armstrong Cork Co."

"Yeah, but - - -"

"Didn't they say they had enough material in their warehouse to do the work?"

"I know, but - - -"

"And didn't they tell you they would send a crew first thing tomorrow morning?"

"That's right, but - - -"

"Well then, why are you so concerned about Armstrong? It seems to me that they're doing all right for themselves."

"Okay, Okay - - - but, believe me, I'm not forgetting them when we make the big changeover next spring."

We'll be pleased, Pete, if you do remember us when the time comes to let the big contract. But you don't have to grant us any special favors just because we were able to help you out of a tight spot this time.

We aren't asking for only the rush jobs—we would much prefer to work at a more normal pace—but we are glad to help out when we can. And since we have warehouse facilities and contract operations in nearly all major industrial areas, we are able to get jobs started and completed in a minimum length of time.

If you would like to know more about the reasons why we were able to help Pete, send for our free booklet, "Armstrong's Contract Service," today. We believe you will find it interesting. Just write to Armstrong Cork Company, Building Materials Division, **7507 Maple St., Lancaster, Pa., today.**

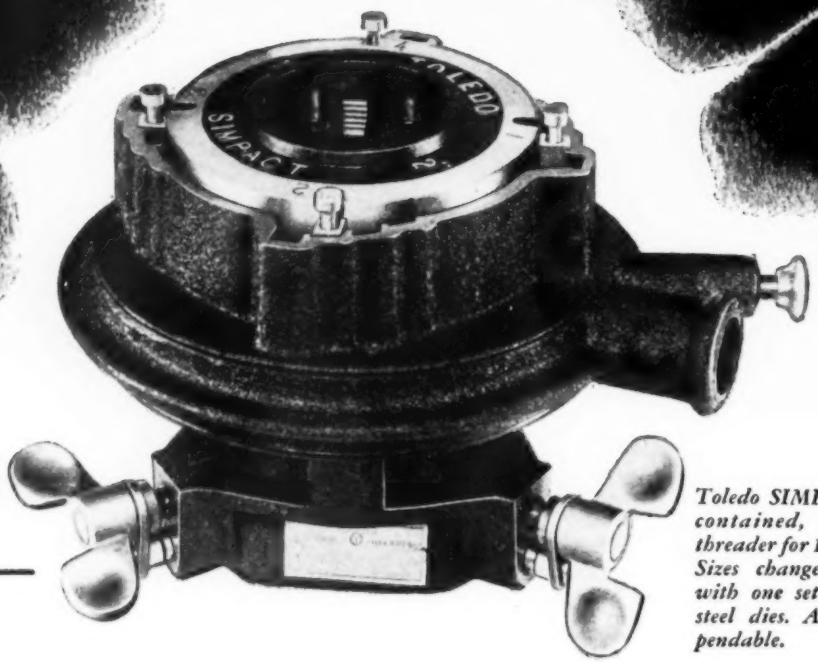
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2600° Fahrenheit

A TOOL YOU CAN TRUST !



Toledo SIMPACT—self-contained, adjustable threader for 1" to 2" pipe. Sizes changed instantly with one set high speed steel dies. Accurate, dependable.

BETTER THREADS . . . LOWER COSTS!

Wherever TOLEDO Pipe Tools are on the job—there's satisfaction!

For nearly half a century, experienced hands have relied on these easy-threading tools. They're engineered for accuracy . . . dependability . . . and time-saving operation. This assures better threads . . . lower costs . . . with TOLEDO efficiency!

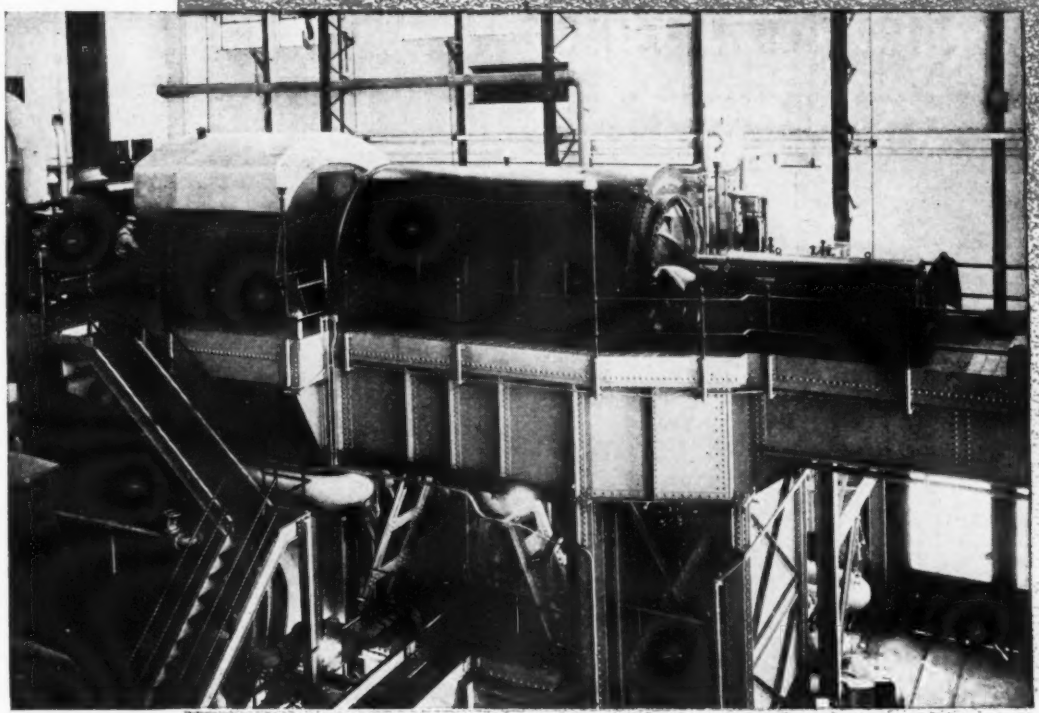
Today's urgent demands for new homes and new commercial and industrial building calls for the best in pipe tools. Specify TOLEDO—a tool you can trust! The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector Street Building.

RELY ON THE LEADER . . .

TOLEDO

FOR PRECISION PIPE TOOLS

PROTECTED BY OIL . . . .



FREE OF DIRT AND

FREE OF WATER . . .

A DE LAVAL Oil Purifier in this power plant keeps the lubricating oil clean. And "clean" means ***really*** clean — free of dirt and free of condensate or other moisture.

When purifying oil, it is not enough to remove solid contaminants only. Water, in the form of condensate or from any other source, can do far too much damage in too short a time to allow it to remain in the lubrication system. A De Laval centrifugal removes such water by centrifugal force, continuously discharging it. Since the dirt is simultaneously separated from the oil and stored outside of the zone where purification takes place, the oil is restored to a condition most nearly comparable to that of new oil, and the turbine — or any other power unit — receives maximum protection.

De Laval Oil Purifiers have long been used by America's leading power plants. 94 per cent of the largest plants in the country have installed De Laval Oil Purifiers for the purification of either turbine oil or insulating oil.

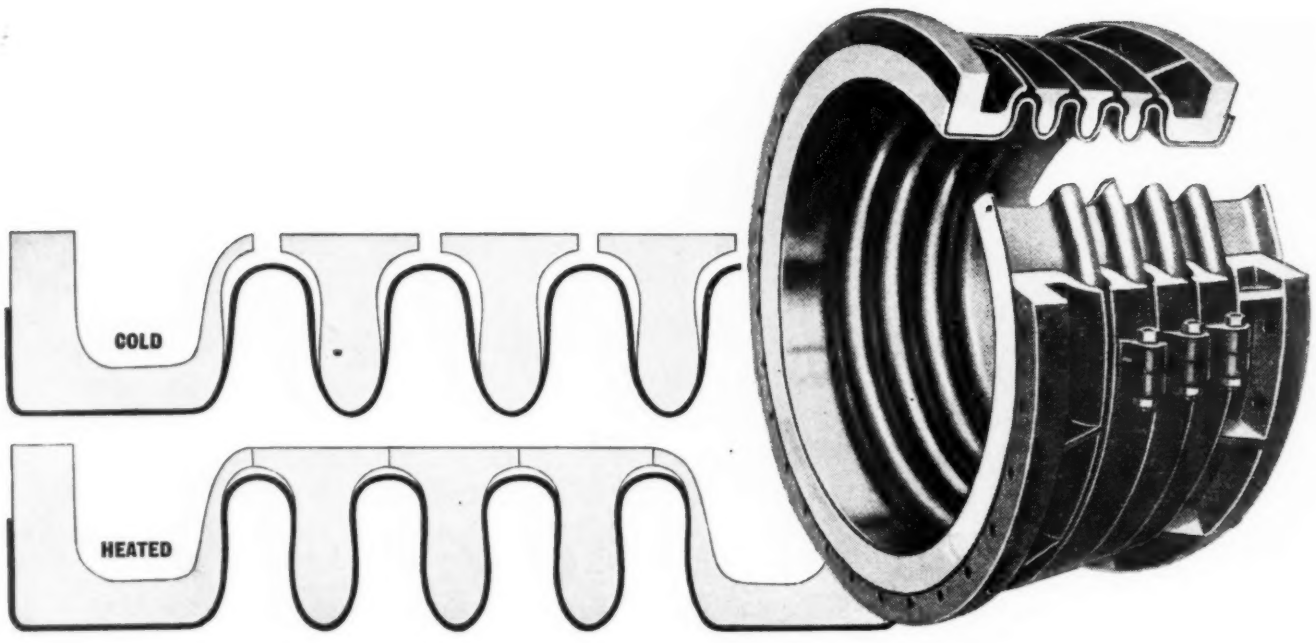
DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

LUBRICATING OIL PURIFIERS

ALL-CURVE DIRECTED FLEXING

***All points of the surface of each corrugation* share its individual load equally—*all the corrugations* share the stress load equally.**



E. B. Badger & Sons Company is the original and sole manufacturer of BADGER Expansion Joints

HIGH-TEMPERATURE and high-pressure stresses simply can't localize in a Badger Corrugated Expansion Joint. They can't break through the cordon of rings which limit their movement. *ALL-CURVE Corrugations* and *ALL-CURVE Directed Flexing Equalizing Rings* keep things orderly. They distribute flexing stresses evenly, as explained in the caption above . . . prevent excessive strain at any point and at any time.

No other expansion joints have this exclusive combination of features. They, with special methods of forming which prevent forming stresses and a special heat treatment which preserves flexing qualities, make Badger the most dependable and longest lasting corrugated expansion joints you can adopt.

They're the most economical, too, from the installation and maintenance standpoint. No needless oversizes. No costly manhole or tunneling expense. Constructed from a single piece of tubing, Badger Joints require no packing maintenance. They take up no more space than the normal flanged fitting.

Badger Packless Directed Flexing Corrugated Expansion Joints are built with known factors that leave nothing to guesswork. You can readily determine the number of corrugations needed, since the maximum traverse per corrugation is consistent for each size. For example:

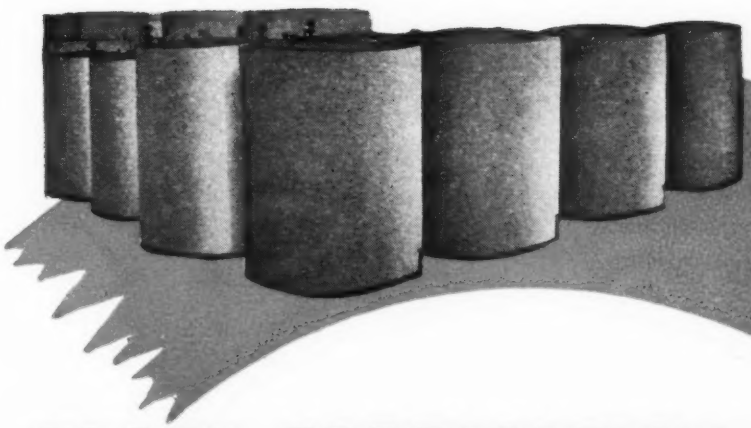
Diameter	*Depth of Corrugation*	*Max. Traverse per Corrugation*
4" and 5"	1⅛"	5/16"
6"	1¾"	½"
8" and 10"	2¼"	5/8"
12" and larger	2¾"	¾"

MADE IN COPPER, STAINLESS STEEL AND OTHER ALLOYS — Copper for normal pressures and temperatures; Stainless Steel and other alloys for higher requirements—and where corrosion is a problem. Single or multiple corrugations—for traverses from a fraction of an inch upward. Also made in Non-equalizing type (without rings) for uses that do not require added protection. SEND FOR BULLETIN No. 100 *(Self-equalizing)* or No. 200 *(Non-equalizing)*.

Badger

E. B. BADGER & SONS CO., 75 Pitts St., Boston 14, Mass.
AGENTS IN PRINCIPAL CITIES

PACKLESS CORRUGATED EXPANSION JOINTS



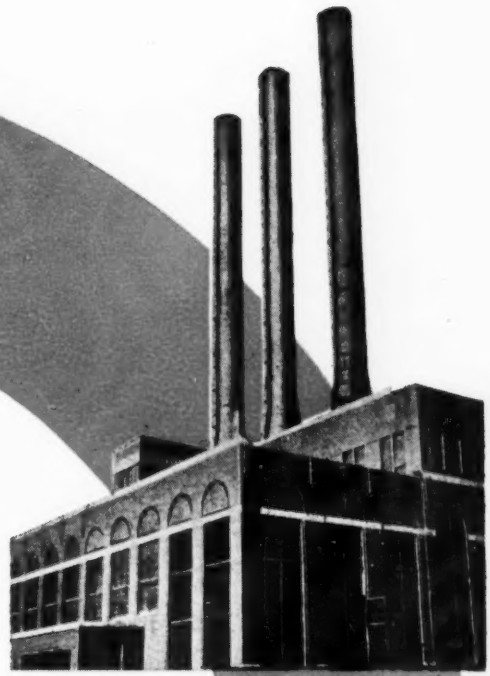


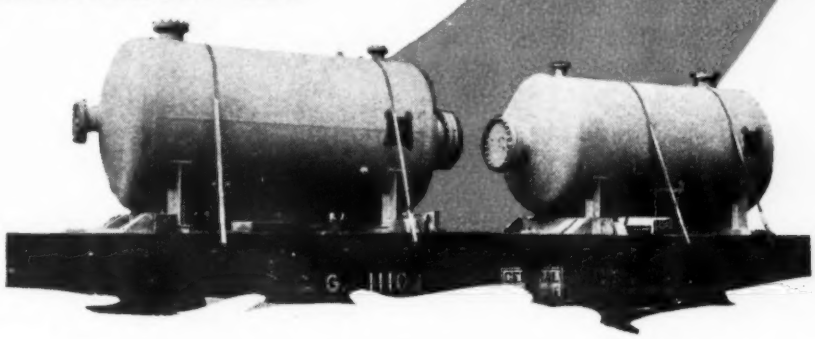
PLATE FABRICATION FOR POWER PLANTS

. . . requires experience and adequate facilities.

General American has the facilities and the experience to do this type of work.

Excellent X-ray equipment, heat treating and stress-relieving furnaces, plus years of experience in fabricating a wide range of carbon, stainless, alloy steels and clad materials are at your disposal. Also we maintain a Field Erection Department to erect equipment shipped in a knocked-down condition.

Put this experience to work for you by asking for our recommendations and quotation.



OTHER GENERAL AMERICAN EQUIPMENT

STORAGE TANKS, WATER — OIL
STEAM DRUMS *PENSTOCKS*
STANDPIPES *STEEL STACKS*
LARGE DIAMETER PIPE

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TRANSPORTATION CORPORATION
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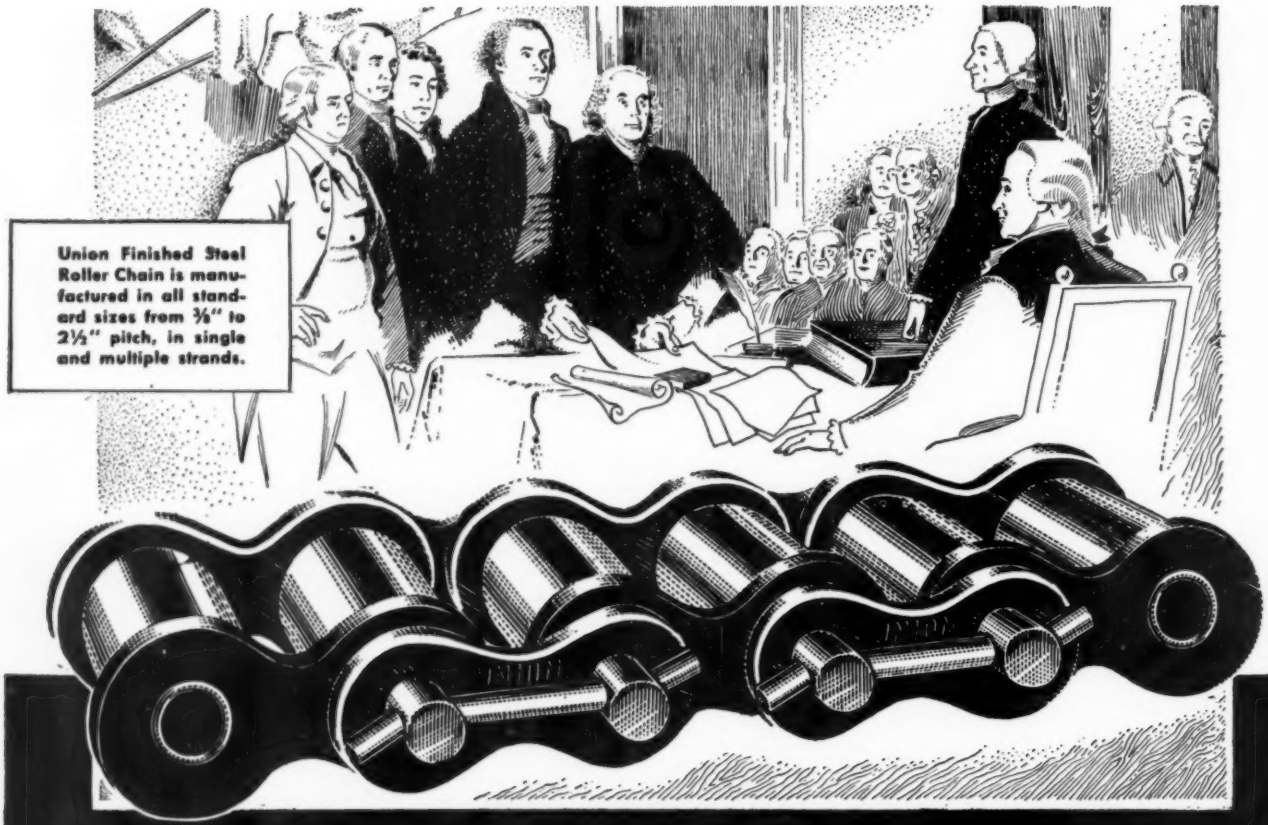


Union Finished Steel Roller Chain is manufactured in all standard sizes from ⅜" to 2½" pitch, in single and multiple strands.

Union Chain's Declaration of Independence

☆ Just in case you don't know it, we at Union Chain are independent . . . independent from any responsibility for products other than steel chains and sprockets. Like national independence, ours provides advantages which you are invited to enjoy. All of our thinking and manufacturing is devoted solely to Union Machine Finished Roller Chain, Union Drive and Conveying Chain, and Union Silent Chain, along with their proper sprocket wheels and attachments. This independence from other obligations and responsibilities could be called specialization. Whatever you call it, Union Chains and Sprockets will often demonstrate its benefits. Declare your independence from the chain you have been using and find out for yourself.

The Union Chain and Manufacturing Company, Sandusky, Ohio, U. S. A.

Union Chains for Every Application

Drive and Conveying Chains and Sprockets
- Bridge Chain
- Combination Malleable Iron and Steel Chain
- HB (hardened bearing) type chain
- BP (bar and pin) type chain

★

Finished Steel Roller Chains and Sprockets
- All manufacturer's standard, size ⅜ in. to 2½ in. pitch
- Single and Multiple Strands
- Extended Pitch Series in sizes 1¼ in. to 4 in. pitch

★

Silent Chain and Sprockets
- All sizes ⅜ in. to 1½ in. pitch

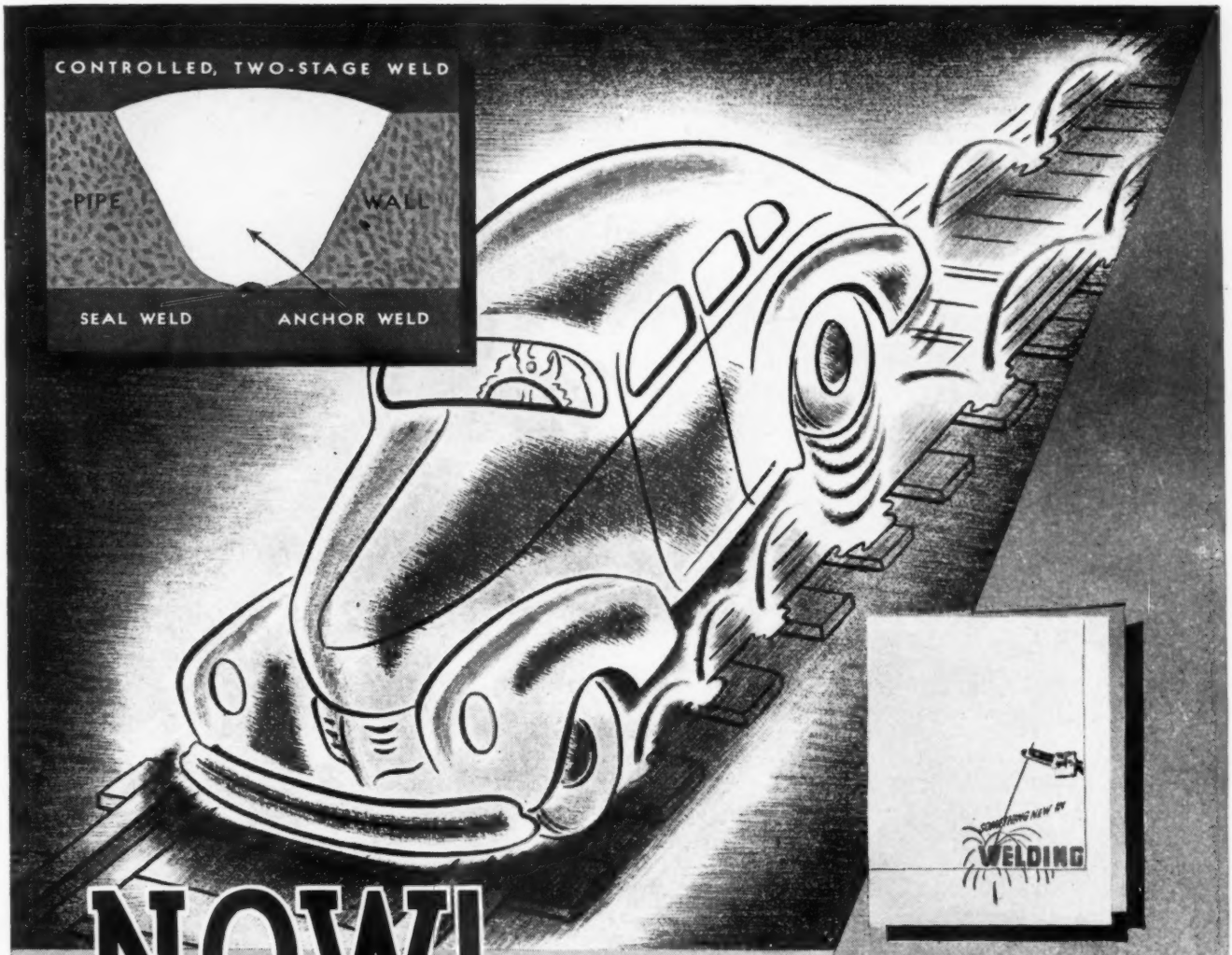
★

Flexible Couplings
- Roller chain type
- Silent chain type

Catalog A-2 covers Drive and Conveying Chain. B-2 covers Finished Steel Roller Chain. FC-1 covers Flexible Couplings. Ask for your copies.

ARMY ★ NAVY

UNION CHAINS



NOW! NOTHING LIKE THIS INSIDE OF BUTT WELDED JOINTS*

Exaggerated, yes; we're merely trying to emphasize the effect of backing rings on flow in butt welded pipelines. And if the ends of the pipe lengths are recessed to lessen these "humps," pipe strength is sacrificed. And if no rings are used, protrusions of weld metal produce the same "humps" again, but they are rough-jagged, except where the patented Westport Method of Controlled, Two Stage Welding is used. This produces a pipe contour, smoother on the inside than on the outside, with maximum bondage and strength. . . . Our bulletin "Something New in Welding" tells the complete story. Write for it today. And remember, while our shop pre-fabricated piping can be made with any type of joint, we believe you'll prefer and specify the Westport, after you read our bulletin.

WESTPORT JOINT

*MADE WITHOUT BACKING RINGS BY THE MITCHELL-WESTPORT METHOD

(PATENTED)

W. K. MITCHELL & CO., INC.
2944 ELLSWORTH STREET
PHILADELPHIA 46, PA.
SINCE 1899

MITCHELL

PIPING FABRICATORS AND CONTRACTORS

What . . . roller expand heat exchanger tubes this small?

A watchmaker's job? You might call it that. Roller expanding ¼ and ⅜ inch tubes into tube sheets *is* a delicate operation . . . *does* require careful control and extraordinary skill.

But Ross is known for such leadership . . . not only in roller expanding tubes, but in the design and manufacture of the expanding tool itself. That's the very reason you have the same permanently tight tube joints in all Ross heat exchangers, large or small, regardless of the size and number of tubes.

Over 50,000 heat exchangers, with ¼ inch roller expanded tubes, have been built by Ross . . . and over 30,000 more with ⅜ inch tubes for the U. S. Navy (to U.S.N. Spec. 66-C1).

Ross Heater & Mfg. Co., Inc., 1415 West Ave., Buffalo 13, N. Y. Division of American Radiator & Standard Sanitary Corp. In Canada, Ross equipment is manufactured and sold by Horton Steel Works Ltd., Fort Erie, Ontario.

HEAT EXCHANGERS
COOLERS
HEATERS
CONDENSERS
ROSS

DOUBLE-TIME DUTY WITH...

TWIN BWH CONVEYOR BELTS!

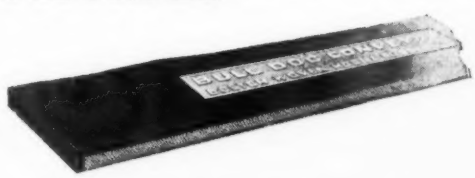
Like many another company, a Midwest power producing plant was called on to increase vastly its output in the war years. In doing it, equipment took an awful beating . . . and these BWH twin conveyor belts worked double time—16 full hours a day, year after year. In addition, the belt speed was increased one third . . . but these rugged belts took it in their stride.

Multiplied instances like this have proved that BWH Conveyor Belts are able to absorb more punishment than they were originally designed to take. Made by the famous ROTOCURE process of continuous vulcanization, they have won the unqualified acceptance of many leading companies over the country.

When next you need a conveyor belt, look to BWH for dependable ruggedness... BWH distributors for dependable service!

HAVE YOU A JOB WHERE STAMINA COUNTS?

Bring us your toughest problems . . . we're specialists in solving them. Consult your nearest BWH distributor, or write to BWH direct.



BOSTON WOVEN HOSE & RUBBER COMPANY

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How to make your place of business QUIET... MORE EFFICIENT with K&M Sprayed "Limpet"* Asbestos

Applicator: Porter-Trustin Co.
Omaha, Neb.
Architect: Leo A. Daly Company

Farmers Union State Exchange Offices. This acoustically treated ceiling is covered with Sprayed "Limpet" Asbestos—notice the smooth, unbroken surface that assures maximum sound deadening efficiency.

IF YOU want to increase the efficiency of your organization, K&M Sprayed "Limpet" Asbestos sound-absorbing material holds the perfect solution.

Applied to the ceilings of your offices, laboratories, testing rooms, or other noise-ridden places, Sprayed "Limpet" Asbestos will not only muffle bothersome sounds through diaphragmatic action, but will absorb it still further through porosity. The resulting quiet atmosphere will make for better concentration, greater employee output, smoother operation and pleasanter working conditions.

Because K&M "Limpet" Asbestos is applied as a blanket-like coating by means of a special spray process, it leaves no seams, no joints, covers all surfaces whether curved, irregular or flat. It can be painted over and over again without impairing its acoustical efficiency. It is fire-proof, vermin-proof . . . and in addition to its sound-absorbing qualities, "Limpet" Asbestos has high thermal insulation value. Write to us for complete information on this remarkable, quiet-producing material.

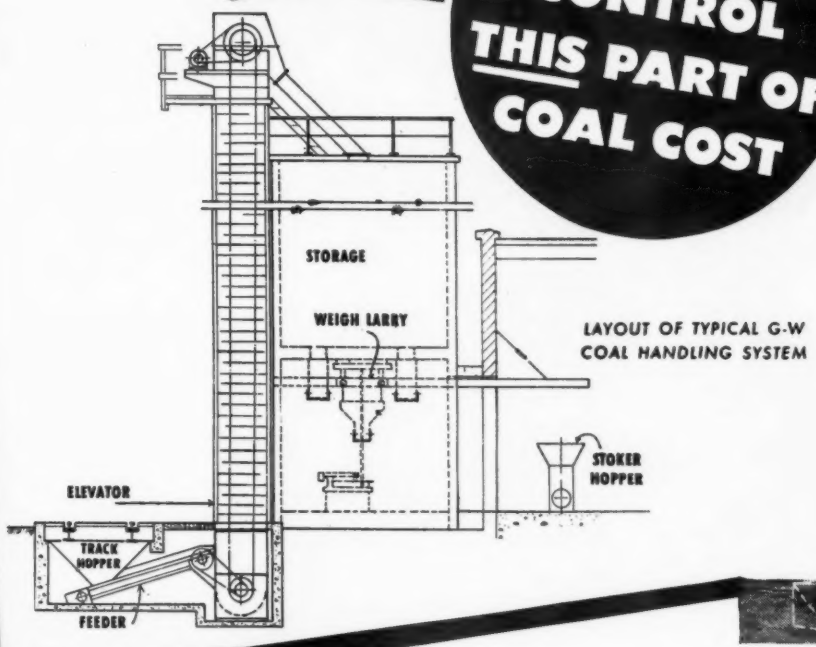
K&M best in asbestos

Nature Made Asbestos..
Keasbey & Mattison
has been making it serve
mankind since 1873

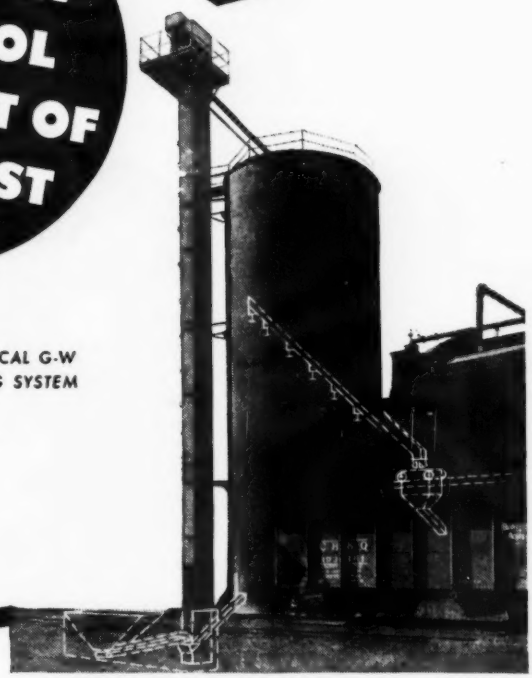
*Trade Mark Reg. U. S. Pat. Off.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

YOU CAN CONTROL THIS PART OF COAL COST



LAYOUT OF TYPICAL G-W COAL HANDLING SYSTEM



Handling coal automatically, from track hopper to storage to stoker, by G-W Elevator and Weigh Larry.

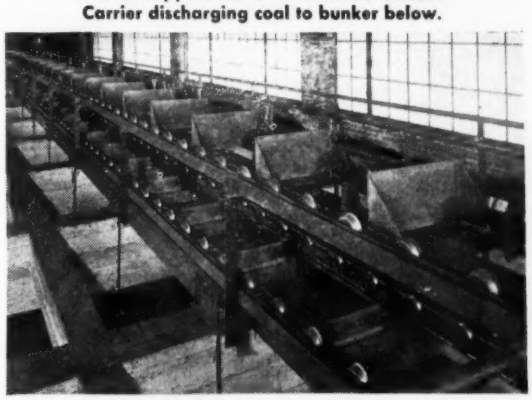
How much does handling add to the cost of coal *after it is delivered to your plant?* If your conveying equipment is obsolete or has outgrown your needs — or if you still cling to manual coal-handling methods — you are adding a substantial amount to the coal costs *inside* your plant.

Cut the additional cost between delivery *at track hopper* and delivery *to stoker hopper* with a G-W Handling System. This simple, typical arrangement is saving money in many plants, large and small. G-W equipment includes all types of conveyors, carriers, elevators and skip hoists; bunkers, gates, spouts, hoppers, weigh larries; storage pockets and industrial rail systems.

G-W engineers are trained to fit the proper equipment to specific coal-handling requirements; G-W shoulders all details from design to installation, assumes all responsibilities. G-W has specialized in this complete service for 130 years. Gifford-Wood Co., 420 Lexington Ave., New York 17; 565 W. Washington St., Chicago 6. — Factory: Hudson, N. Y.

HANDLING HEADQUARTERS
for Industrial Conveying Systems • Infra-Red Baking and Drying Equipment • Ice Processing and Handling Machines.

Fixed trippers of G-W Pivoted Bucket Carrier discharging coal to bunker below.



G-W Flight Conveyor distributing coal over large bunker above boiler room.

1541

GIFFORD-WOOD
SINCE 1814

G-W HANDLES IT...
faster • easier • cheaper

Here's a "POWERFUL" story FOR Power Plants

RIC-WIL
on the job
Steam Sales
IMPROVE OPERATION OF MUNICIPAL POWER PLANT
and save one customer $20,000 per year in power costs
Case History
of the Piqua Municipal Power System, Piqua, Ohio

● Any architect, engineer, contractor, utility director or city commissioner interested in efficient power distribution will find this case history extremely helpful. It shows how, by adding steam sales, the Piqua Municipal Power system was able to plan a long range expansion program on a sound basis —at the same time bringing to the community all the benefits of "Central Heating"—smoke and soot abatement, reduction of fire hazards, fuel and manpower savings resulting from elimination of individual heating plants and of private coal delivery and ash removal. It also shows the important part Ric-wiL played by providing a modern steam distribution system.

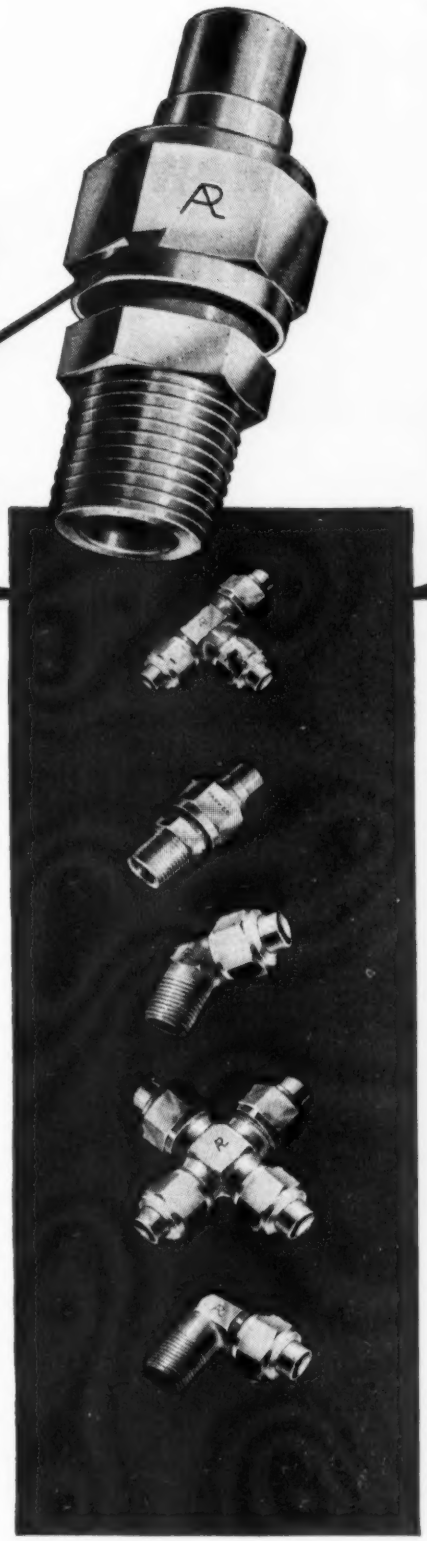
Write for your copy today.

RIC-WIL INSULATED PIPE CONDUIT SYSTEMS
THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

FOR TROUBLE-FREE

Tube Couplings

LOOK FOR THE AR*



Easier to install, safer to operate, quicker to service—in tube couplings the Parker trade-mark means all these.

The exclusive patented design of the Parker Triple Coupling insures a joint that is pressure-tight, leakproof—and vibration-protected. Parts are self-aligning. That cuts installation time. They're completely interchangeable, too. You can disassemble them in a matter of minutes—even in tight spots.

Regardless of the size or type of fitting you need, there's a standard Parker Coupling to meet your requirements—and each has the same outstanding features. The Parker line is complete. It includes a wide variety of types—in brass, steel, stainless or aluminum—and in sizes from $\frac{1}{8}$" to $1\frac{1}{2}$", standard or heavy weight.

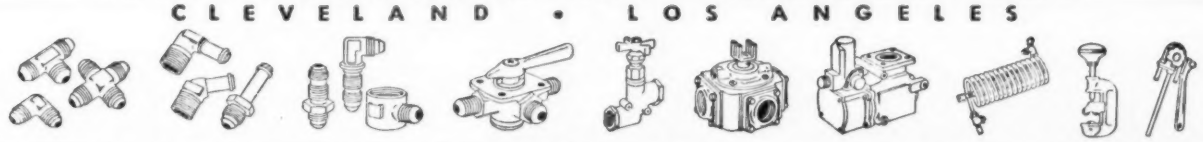
If you don't see the style you require pictured here, ask us for it. Complete stocks are available in our warehouses—or from your jobber. For detailed information see our new Catalog 201-C. The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio. In Canada, Railway & Power Engineering Corporation, Ltd., Montreal, P. Q.

*This famous trade-mark symbol is derived from the initials of our founder, A. L. Parker. Let it serve to remind you that for Alignment, Leak-protection and Pressure-tightness you can't beat Parker Triple Type Couplings.

Parker Couplings are made in stainless steel, too!

THE PARKER APPLIANCE CO.

CLEVELAND • LOS ANGELES

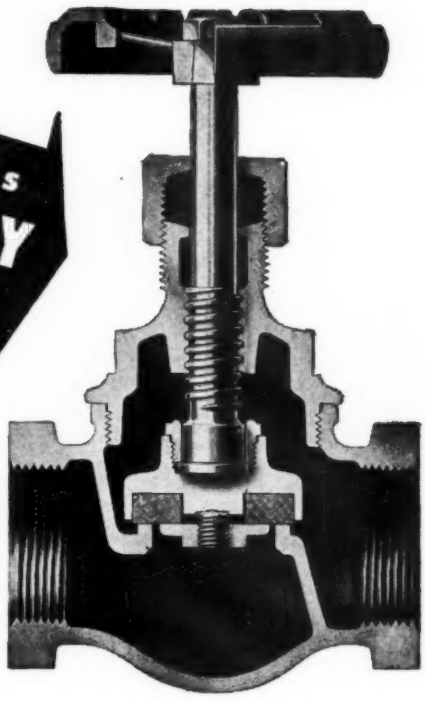


FLUID POWER PRODUCTS FOR ALL INDUSTRY

Every feature you want in a

BRONZE GLOBE VALVE with renewable composition disc

is in this KENNEDY DESIGN



Here is a renewable composition disc bronze globe valve with special features that make it an outstanding value . . . for its features give you extra conveniences, extra service, and extra maintenance savings at no extra cost.

For example, look at the disc . . . the heart of the valve. The disc holder is accurately guided in the body by four guide prongs which prevent tipping or binding, and its stem head recess has a milled bearing surface which permits it to swivel freely. When the stem is turned to wide open position, this slip-on disc holder becomes locked in place so it cannot fall off when the valve is taken apart, but a half-turn of the stem releases it for removal.

Then, too, notice the unusual height of the seat, which gives longer use of the disc before renewal. These are but a few of the extra values of this 150-lb. valve which is fully described in the 240-page Kennedy Catalog. Write for your copy today.

YOU WANT THESE VALVE FEATURES

. . . you'll find them in this KENNEDY design

1. **Generous Strength . . .** Body and bonnet are of high-grade dense metal with ample thickness and rounded fillets. Stem has large diameter and extra large number of contact threads.
2. **Easy Operation . . .** Stem and stem contact surfaces are accurately threaded. Deep stuffing boxes permit tightness without undue pressure on packing. Large handwheel gives firm, comfortable grip.
3. **Lasting Tightness . . .** Discs and seats seat accurately, and their sturdy design resists distortion and has special provisions for take-up of wear.
4. **Long Life . . .** Many Kennedy valves have been in daily use a quarter century and more.
5. **Convenient Repacking . . .** Glands and packing are easily accessible.
6. **Economical Maintenance . . .** Long wear built into all parts, and adjustments or other attention are seldom required.

THE KENNEDY VALVE MFG. CO.
Elmira, New York

KV-112

KENNEDY *valves - pipe fittings - fire hydrants*

CHANGING FUEL is No Worry to Users of ENCO OIL BURNERS with COAL FIRED UNITS

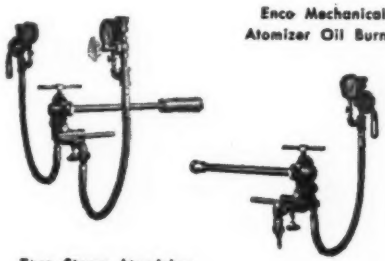
Alternate shortage and abundance of specific fuels have little effect on the operation of power plants that are equipped with Enco Oil Burners in combination with coal burning units.

Changing from coal to oil — and back to coal — can be governed by fuel availability and comparative BTU costs.

With Pulverized Coal Burners either Enco Mechanical or Steam Atomizers are used for ignition and entire load range. Bulletin OB-PC, giving complete details on use of Enco Oil Burners with Pulverized Coal will be sent on request.

With Stoker or Hand Fired Units, this same combination can be made for partial or full loads, either for temporary or permanent application. Complete information on installations of this type will be sent on request.

Enco Mechanical Atomizer Oil Burner



Enco Steam Atomizing Oil Burner

AUTOMATIC, RETRACTABLE OIL-ELECTRIC IGNITION SYSTEM

When used as ignition for pulverized coal, this system permits remote control as per the following lever adjustments:

1. Introduces oil atomizer and electrodes to burner; establishes ignition spark; turns on oil.
2. Retracts electrodes from oil flame vicinity.
3. Shuts off oil and retracts atomizer.

By changing atomizer spray plate, this system can be converted to full oil burning, capable of carrying the full load.

Write today for Bulletin OB-PC giving complete information on Enco Automatic Oil Electric Ignition Systems for use with Pulverized Coal Fired Units.

THE ENGINEER COMPANY ALSO PRODUCES

- Enco Streamline Baffles
- Enco Oil and Gas Burning Equipment
- Enco Fuel Oil Pumping and Heating Units
- Enco Automatic Combustion Control

THE ENGINEER COMPANY

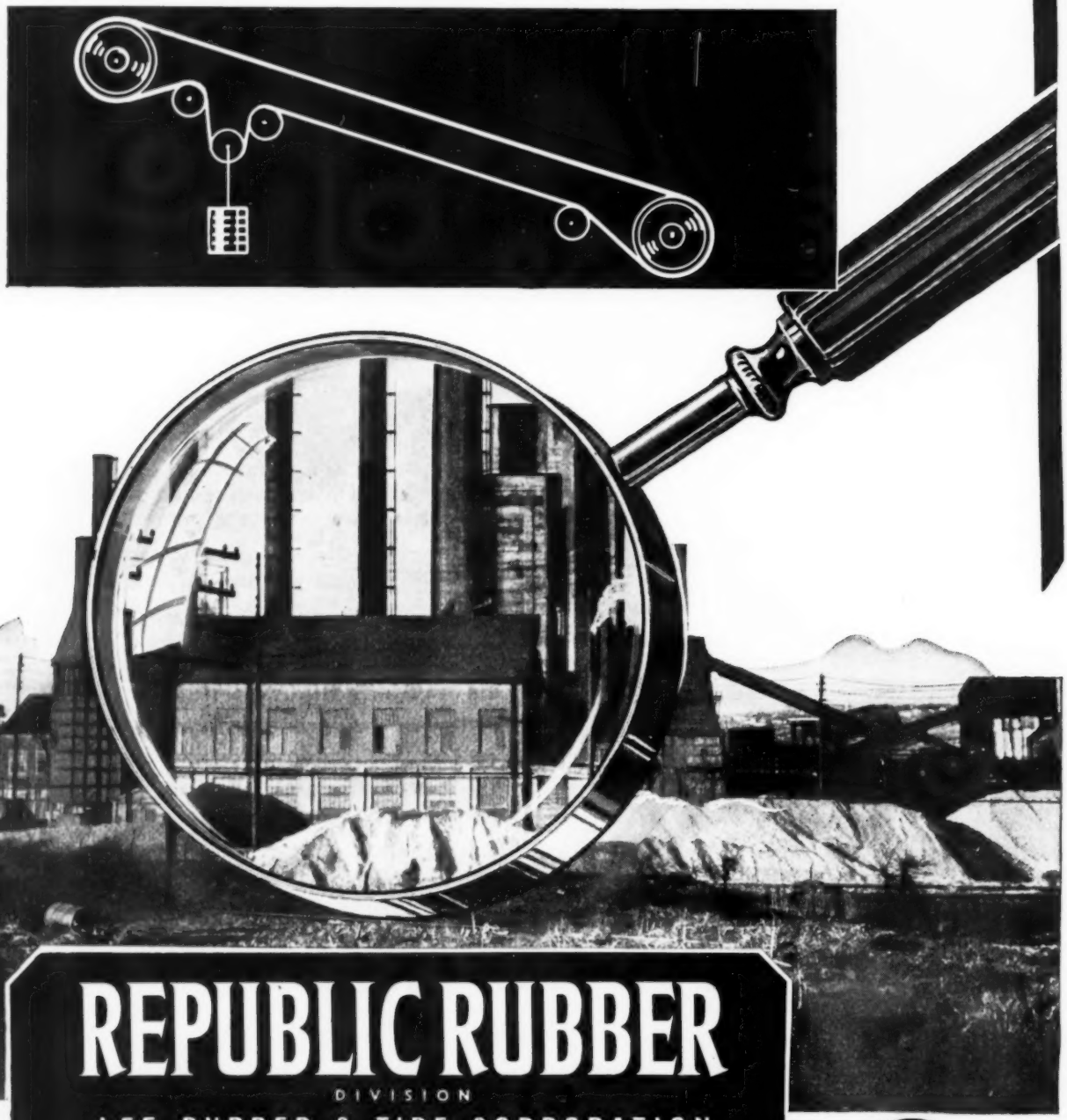
75 West Street
New York 6, N. Y.

Canadian Representative:
F. J. Raskin, Ltd., 370 Rachel E., Montreal, P. Q.

EC-464

A Clear Picture OF YOUR PLANT

A general view of your plant and its requirements for conveyor belt operation has been acquired by Republic technologists through years of exclusive specialization in the manufacture of industrial rubber products. Republic also, long ago, adopted a system of exclusive sales through industrial distributors. This closely knit, national network of local service organizations provides an on-the-spot source for the additional details that fill in the complete picture of your exact needs. From such full knowledge of particular conditions, Republic Conveyor Belting is designed and built with maximum resistance to the specific factors of service. Ask your nearby Republic Distributor for facts on results of his tailor-made conveyor belt recommendations in your own vicinity.



REPUBLIC RUBBER

DIVISION

LEE RUBBER & TIRE CORPORATION

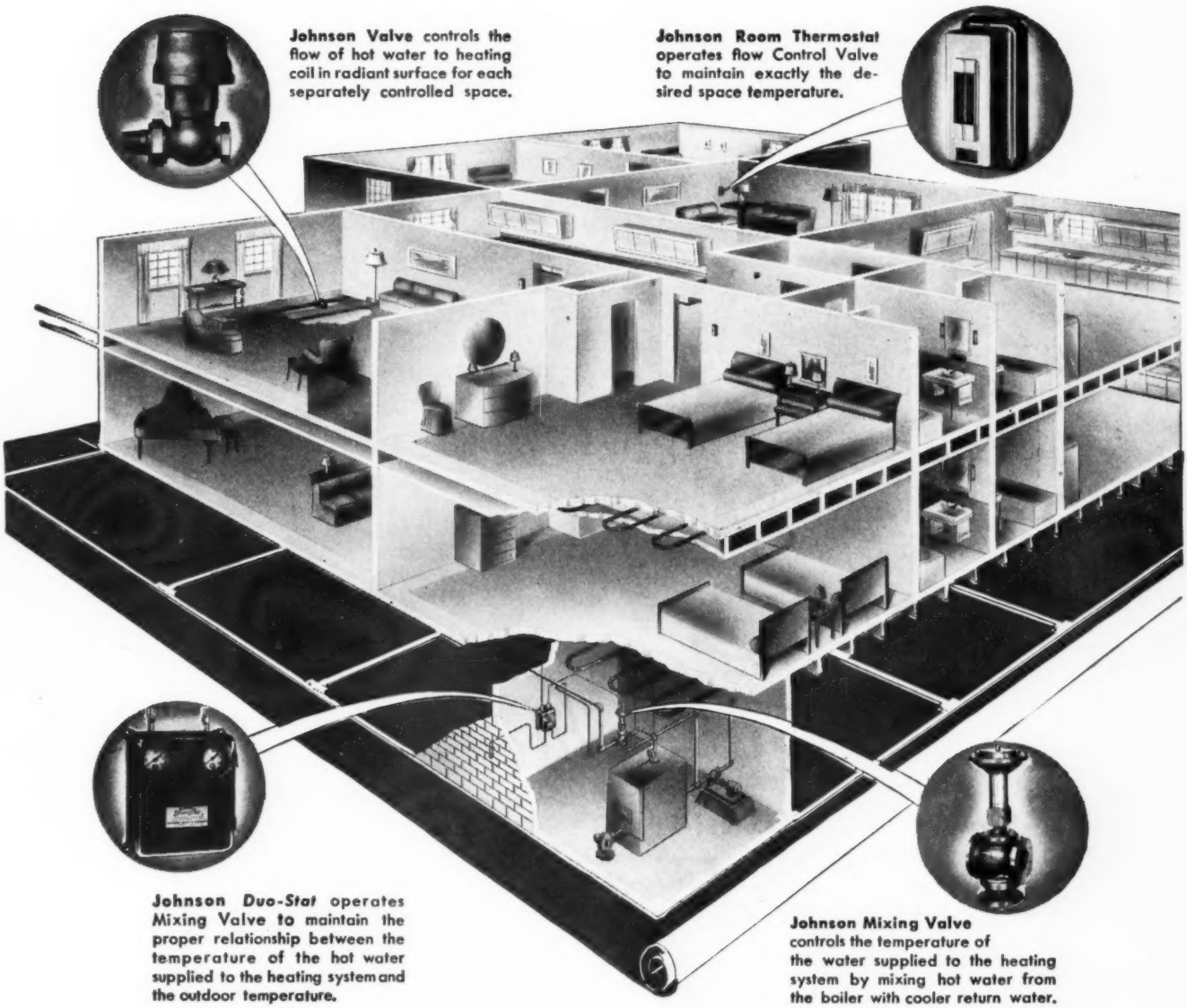
YOUNGSTOWN 1, OHIO

REPUBLIC INDUSTRIAL PRODUCTS
YOUNGSTOWN, O.

LEE DELUXE TIRES AND TUBES
CONSHOHOCKEN, PA.

WE ARE PARTICIPANTS IN THE OWNERSHIP AND OPERATION OF NATIONAL SYNTHETIC RUBBER CORPORATION

HOW TO CONTROL *Radiant Heating*


Johnson Valve controls the flow of hot water to heating coil in radiant surface for each separately controlled space.
Johnson Room Thermostat operates flow Control Valve to maintain exactly the desired space temperature.
Johnson *Duo-Stat* operates Mixing Valve to maintain the proper relationship between the temperature of the hot water supplied to the heating system and the outdoor temperature.
Johnson Mixing Valve controls the temperature of the water supplied to the heating system by mixing hot water from the boiler with cooler return water.

The illustration shows a typical Johnson Automatic Temperature Control System for radiant heating, as applied to an apartment building. This, or other similar Johnson Radiant Heating Controls are available for small and large residences, schools, commercial buildings, hotels, hospitals, industrial plants and almost every conceivable type of building.

The essential of Johnson *Radiant Heating* Control is the *Duo-Stat,* which controls the temperature of the water supplied to the radiant heating surfaces according to the outdoor temperature. This is fundamentally correct. It insures that a change in heat input to the radiant surfaces will occur *immediately* upon a change in weather conditions. With other methods of control, a change in space temperature must take place *before* the required change can be made in the temperature of the water supplied to the radiant heating surfaces.

SEND FOR 20-PAGE BOOKLET, "HOW TO CONTROL *RADIANT HEATING,*" illustrated by diagrams of typical installations

JOHNSON SERVICE COMPANY, MILWAUKEE, WIS.
Direct Branches in All Principal Cities

ADAPTABILITY +

- LOW INITIAL COST
- COMPACTNESS
- EASY INSTALLATION
- SMOOTH, DEPENDABLE OPERATION

Goulds "Close-Cupld" Centrifugals ...

Every modern feature of centrifugal pump design is embodied in Goulds "Close-Cupld" *single* and *two-stage* enclosed impeller pumps. They are built in twenty sizes with three types of mountings, handle from 5 to 1600 G.P.M. with heads up to 525 ft., depending on capacity. Consequently, they are adaptable to widely divergent operating conditions in all types of industrial plants.

On the basis of cost, performance, compactness and ease of installation, Goulds "Close-Cupld" pumps are without equal. Note the six important operating features indicated below. This is the kind of engineering that makes Goulds pumps such outstanding performers. Whether you require a "Close-Cupld" or any other type of centrifugal pump, contact Pump Headquarters or your nearest Goulds office.

6 IMPORTANT "CLOSE-CUPLD" FEATURES

1. Eccentric design of suction nozzle avoids formation of air pockets . . . keeps pump at full capacity.
2. Shaft sleeve extends through stuffing box, impeller hub and past end of motor shaft and is effectively sealed against leakage between shaft and sleeve. Full protection for motor shaft means longer life.
3. Shaft sleeve is free to expand at gland end, an exclusive feature and important when handling liquids of varying temperatures.
4. Deep stuffing box (2¼ times shaft sleeve diameter minimum) assures tight seal, an important safety factor on volatile liquids.
5. Motor shafts tested for running balance at all speeds, important for life of all running parts.
6. Renewable wearing parts, such as casing wearing rings and shaft sleeves, lengthens life of pump unit.

Goulds PUMPS, INC.
the PUMP FOR the JOB SENECA FALLS, N.Y.

IT'S CLEAN!

DOWN TO THE SMALLEST TUBE AND *EVERY* CURVED SURFACE

...AND THAT IS ONLY ONE ADVANTAGE OF ICI SCALE AND SLUDGE REMOVAL SERVICE

The superintendent of a corporation whose million-dollar boiler installation was cleaned, voluntarily wrote . . . "After our boilers were cleaned with the special scale remover, the scale was *completely removed*" . . . and further added . . . "It was necessary to have the boilers out of use only 24 hours instead of the usual two weeks."

INTERNATIONAL CHEMICAL SERVICE is extremely successful for removing steam-deposited sludge and scale from boilers, economizers, condensers, feed water heaters, cooling jackets, water lines, and similar installations. The chemical solvents penetrate wherever water can flow, so that *all* interior surfaces are thoroughly cleaned, including small tubes, curved areas, and turns which are practically impossible to clean by mechanical means.

Heat transfer units are quickly restored to original efficiency—excessive cost of manual cleaning is eliminated—no dismantling or disassembly is necessary—and time off the line is reduced to a matter of hours.

GET THE FACTS ON YOUR CLEANING PROBLEM

Operators in the Western States of medium or large installations of equipment subject to accumulations of scales and sludges, are invited to secure a scale analysis, recommendations for its removal, and a definite estimate of cost of service. No cost or obligation is incurred in KNOWING how this serious problem can be solved readily, successfully and at far less cost than by any previous methods. An illustrated, descriptive Bulletin is available upon request. A sound slide film covering chemical cleaning is available, without obligation, to industrial plants and to engineering groups in the Western States.

SUCCESSFUL IN VARIOUS INDUSTRIES

BOILERS . . . a 3000 HP Stirling Type Boiler, with integral economizer, was completely cleaned of scale in less than 24 hours.—CONDENSERS . . . a total of 4,000, ¾-inch O.D. condenser tubes 30 feet long were cleaned in 2 hours without removing heads.—WATER LINES . . . an 8-inch buried water line, 700 feet long, was completely cleaned of a serious accumulation in 8 hours time, the solvent flowing through the regular connections without disturbing the installation.

IDEAL FOR MARINE SERVICE

Boilers, evaporators, condensers, oil coolers, water and fuel tanks are readily cleaned using International dock-side equipment.

CHEMICAL SERVICE DEPARTMENT

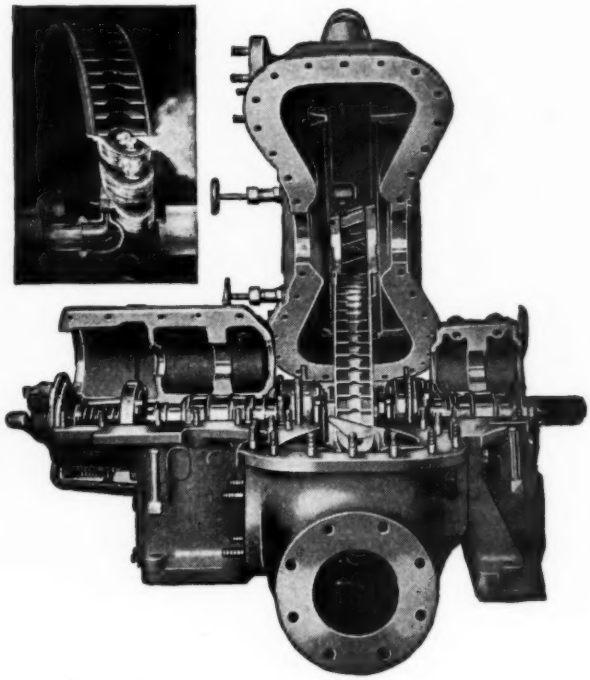
INTERNATIONAL CEMENTERS, Inc.

GENERAL OFFICES: 3605 Long Beach Blvd. (Mail address Box 5005, Long Beach 5, Calif.) Los Angeles Phone NEvada 62493 - Long Beach Phone 48591 . SERVICE OFFICES: Long Beach, Calif. Phone 48591 - Bakersfield, Calif. Phone 30255 - Oakland, Calif. 1629 Telegraph Ave. (Zone 12) Phone Glencourt 5838 - Casper, Wyo. Phone 972

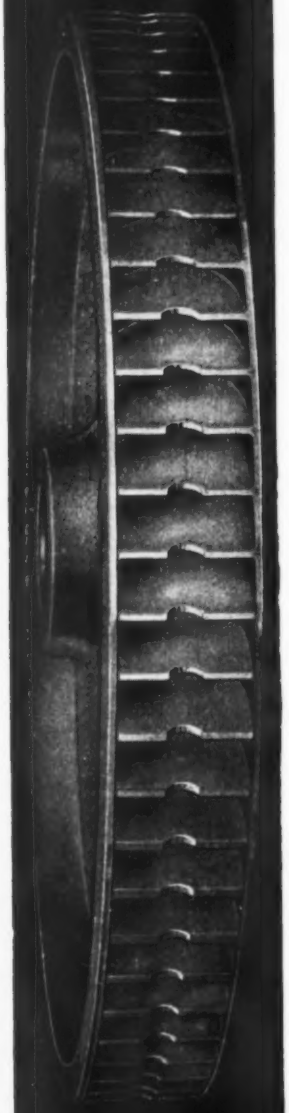
Licensed under processes practiced by DOWELL, INCORPORATED, a subsidiary of THE DOW CHEMICAL CO.

TERRY

Action of steam in Terry solid wheel and reversing chamber.



Typical Terry Solid Wheel Turbine with casing cover and bearing caps raised. Note ruggedness and the accessibility of all parts. Units of this type are used to drive all types of power plant auxiliary equipment built in sizes from 5 H.P. to 2000 H.P.



THE TERRY WHEEL TURBINE- FOR AUXILIARY DRIVE— OFFERS MANY ADVANTAGES

FROM THE SMALLEST TO THE LARGEST, THESE RELIABLE TURBINES HAVE—

- ★ Indestructible one piece wheel.
- ★ Large radial and axial clearances.
- ★ Double rim protected blading.
- ★ Individual nozzle control.
- ★ Dependable and durable governor.
- ★ Heavy dust-proof bearing and governor housing.
- ★ Independent overspeed trip with separate valve.
- ★ Sturdy casing design.
- ★ Strong and easily inspected steam strainer.
- ★ Truly accessible construction, which makes inspection of the interior parts a simple matter.

FOR FULL DETAILS ASK FOR BULLETIN S-116.

T-1157

THE TERRY STEAM TURBINE COMPANY

TERRY SQUARE, HARTFORD, CONN.

Because they are

5 TIMES AS FLEXIBLE!

Interior View of Tangent Shown Above Clearly Illustrates Uniformity of Corrugations. (Actual size—24" O.D. x ⅜" wall thickness.)

CORRUGATED TANGENTS

Save Space, Relieve Stresses, and Simplify Operation

PITTSBURGH Piping and Equipment Company Corrugated Tangents are at least five times as flexible as a piece of straight pipe of the same length, diameter, and wall thickness.

Their proper use permits more convenient location of valves, makes possible the use of shorter lines without causing excessive stresses or end reactions against equipment, and provides a more compact, dependable system.

This type of piping, in suitable applications, can be used to advantage when replacing, improving, enlarging, or installing a complete new piping system.

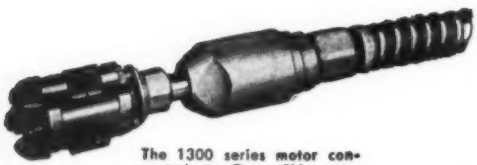
Pittsburgh Piping

AND EQUIPMENT COMPANY

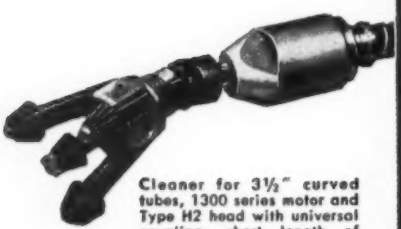
10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Chamber of Commerce Bldg., Indianapolis
Book Tower, Detroit
525 Market Street, San Francisco
634 S. Gramercy Place, Los Angeles
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston
Whitehead Building, Atlanta

Quick DEATH to boiler scale



The 1300 series motor connected to Type PN cutter head for 3" straight tubes.



Cleaner for 3½" curved tubes, 1300 series motor and Type H2 head with universal coupling, short length of hose at rear of motor.

1300 series cleaner for 3" curved tubes with universal joint and drill, short length of hose connected to rear of motor.

1300 series motor equipped with vibrator head for use in removing scale from the outside of fire tubes.

For curved tubes a short-bodied 1300 series motor is used with universal joint between motor and Quick Repair head and a short length of hose at the rear to give flexibility.

Write today for the Elliott boiler tube cleaner bulletin. If you have an unusually tricky or difficult tube cleaning problem, consult with the nearest Elliott specialist. We will put you in touch.

They call them scale-killers in many boiler rooms. These Elliott (Lagonda Type) 1300 series tube cleaners zip into action and quickly run through scale-clogged tubes leaving them clean as a whistle and ready for business again.

Tube cleaning is a one-pass job with an Elliott cleaner. No need to run it through a second time. And no need to run the motor while the cleaner is being pulled back. Simply haul back and get going on the next tube.

Maintenance men like the way Elliott cleaners operate. They know these cleaners help them get through with the job faster and easier. They like the refinements that make these cleaners swift, powerful — and troublefree.

Rugged cutterheads, all-over lubrication system (including front bearing), super-efficient motor and a streamlined body that gets around tube turns, help make Elliott tube cleaners the kind to have in your own boiler room. Write today for fully detailed bulletin.

ELLIOTT COMPANY
LAGONDA DIVISION, SPRINGFIELD, O.
District Offices in Principal Cities
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.

Y-257

ELLIOTT 1300 SERIES TUBE CLEANERS

SIMPLICITY...

only (3) parts to remove for withdrawal of G-Fin Element

...an EXCLUSIVE TWIN G-FIN SECTION Feature

As a FUEL OIL HEATER . . .

The Twin G-Fin Section is readily installed, easy to clean, and provides flexible capacity for varying fuel requirements with several identical units, making 100% spare heating capacity unnecessary.

As a multi-service HEAT EXCHANGER . . .

The Twin G-Fin Section has finned tubes which compensate for heating or cooling fluids of low heat conductivity; and can be used on many different heat transfer services without change in design.

Disconnect union, remove cone plug lock nut and shell cover . . . that's all you need to do for withdrawal of the G-Fin element from a G-R Twin G-Fin Section.

This SIMPLICITY . . . inherent in the Twin G-Fin Section . . . is typical of the practical, distinctive design of these units. Additional features obtainable ONLY in the G-R Twin G-Fin Section are the mechanical bond between fins and pipe, proven by years of service and more than 40,000 installed sections . . . the removable return bends which make cleaning of tube interiors easier . . . G-Fin elements are also available in non-ferrous as well as ferrous alloys.

More than a dozen other advantages have made these standard interchangeable units the most widely used heat exchangers on the market . . . adapted to a greater variety of condensing, cooling and heat exchange services than any other design of heat transfer apparatus. Bulletin 1614 explains why . . . your copy sent on request.

THE GRISCOM-RUSSELL CO.
285 Madison Ave. New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

CYCLOTHERM ENGINEERING AND DESIGN ASSURES

Perfectly Balanced Operation

20 HP High Pressure Unit

Combine simplified design with highest operating efficiency

Cyclotherm Steam Generators represent the most modern development in the steam production field. Each Cyclotherm unit is a completely self-contained and fully automatic steam generating plant. All components of Cyclotherm units are individually engineered or specially selected by Cyclotherm's design engineers for *perfectly balanced* operation.

Cyclotherm units are manufactured with all the simple and advantageous features of two pass boiler construction—yet perform with the highest operating efficiency. This is possible because of the exclusive Cyclotherm method of combustion and heat transfer.

Oil or gas fired

All Cyclotherm units may be operated with either light oil or gas or equipped with combination oil-gas burners which permit the changeover from one fuel to the other by merely throwing a switch. Models from 50 HP to 200 HP may be fired with either heavy oil or gas. On these larger models firing rates are automatically modulated from 30% to 100% of rated capacity—without loss of operating efficiency.

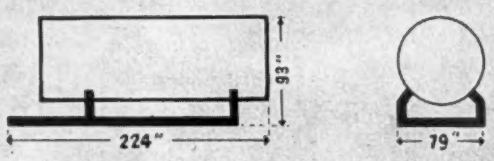
Cyclotherm units are fully equipped with automatic operating and safety controls and are completely assembled and tested at the factory.

Cyclotherm is ready to deliver steam upon arrival after connection to water, fuel and electric lines.

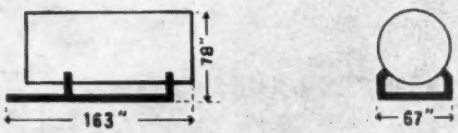
Write, wire or phone for more information.

NOTE FAVORABLE "GO THRU" DIMENSIONS
A Cyclotherm may be installed anywhere —functions without foundation or stack.

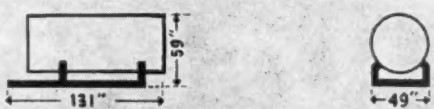
200 H. P. MODEL



100 H. P. MODEL



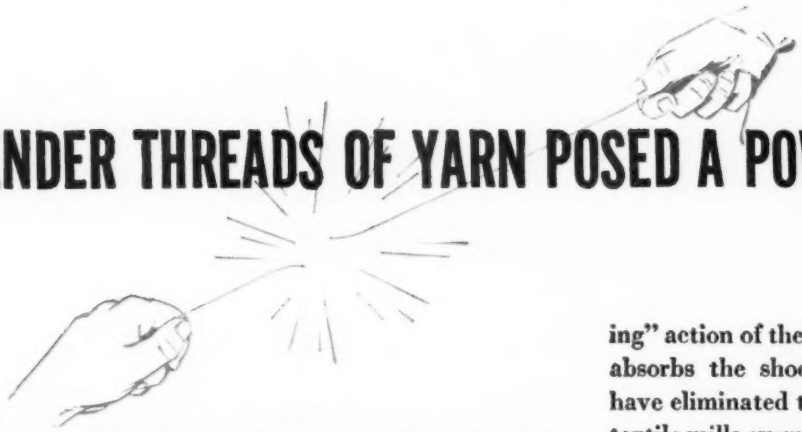
40 H. P. MODEL



CYCLOTHERM STEAM GENERATORS

CYCLOTHERM CORPORATION, 90 BROAD STREET, BOX 902, NEW YORK 4, N. Y.

SLENDER THREADS OF YARN POSED A POWER DRIVE PROBLEM



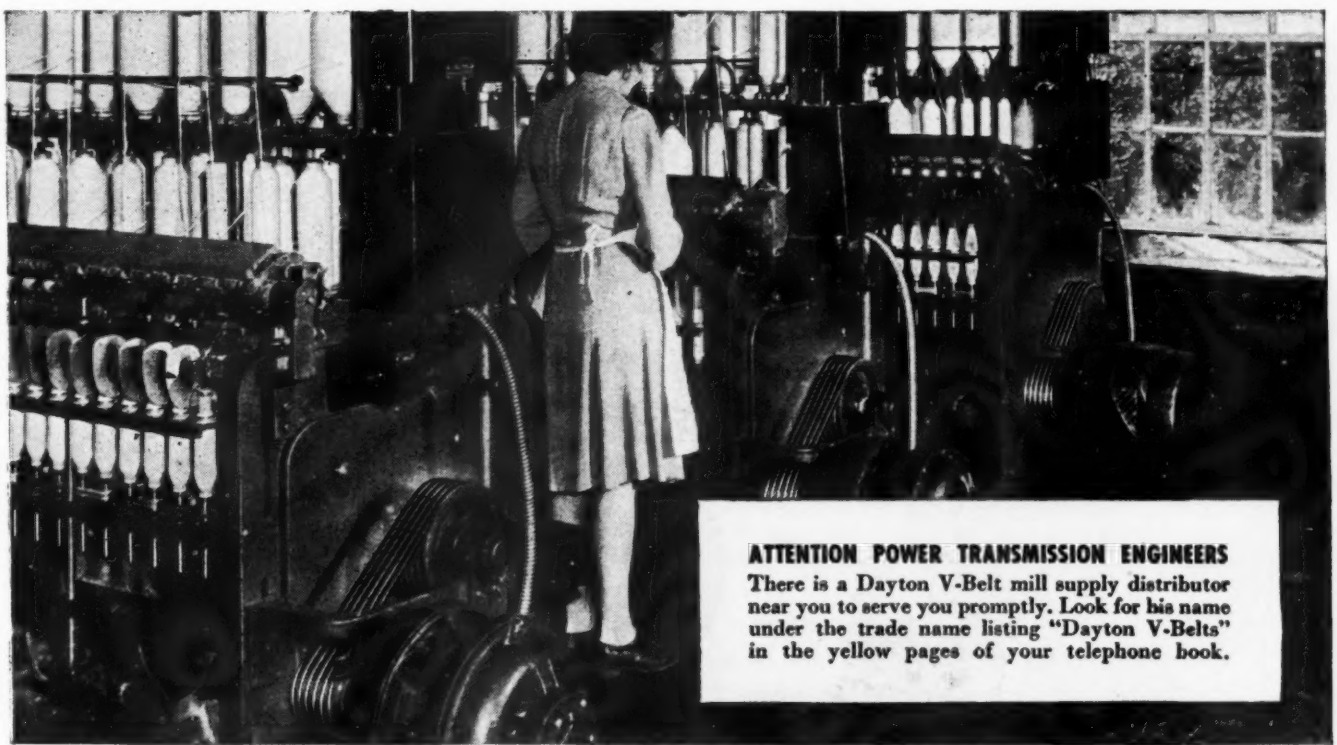
Now textile machines equipped with

Dayton V-Belt Drives

START SMOOTHLY...RUN SMOOTHLY

and tiny strands of yarn no longer break

Abrupt, jerky starts of other types of power drives on textile machines caused the yarn to break frequently, often necessitated machine shut-downs with resulting production losses. Now the *engineered* resilience of Dayton V-Belts, and the "seating" action of the belts in the pulley grooves which absorbs the shocks of suddenly applied power, have eliminated these production losses in leading textile mills everywhere. In many other industries, too, Dayton V-Belt Drives have increased machine efficiencies because they transmit power *smoothly* and *positively*, making precise power control possible. These advantages have been *engineered* into Dayton V-Belts as the result of 40 years of research and experience working with natural and synthetic rubbers, perfecting *specialized* rubber products for specific industrial jobs. Let Dayton V-Belts solve your power transmission problems. Write for full information to The Dayton Rubber Manufacturing Company, Dayton 1, Ohio.



ATTENTION POWER TRANSMISSION ENGINEERS

There is a Dayton V-Belt mill supply distributor near you to serve you promptly. Look for his name under the trade name listing "Dayton V-Belts" in the yellow pages of your telephone book.

SEND FOR THE LATEST DAYTON V-BELT CATALOG

The Dayton Catalog No. 280 contains 384 pages of tables and other information that make it possible to select V-Belts for any power transmission drive quickly and accurately. It's free. Write The Dayton Rubber Mfg. Co., Dayton 1, Ohio.

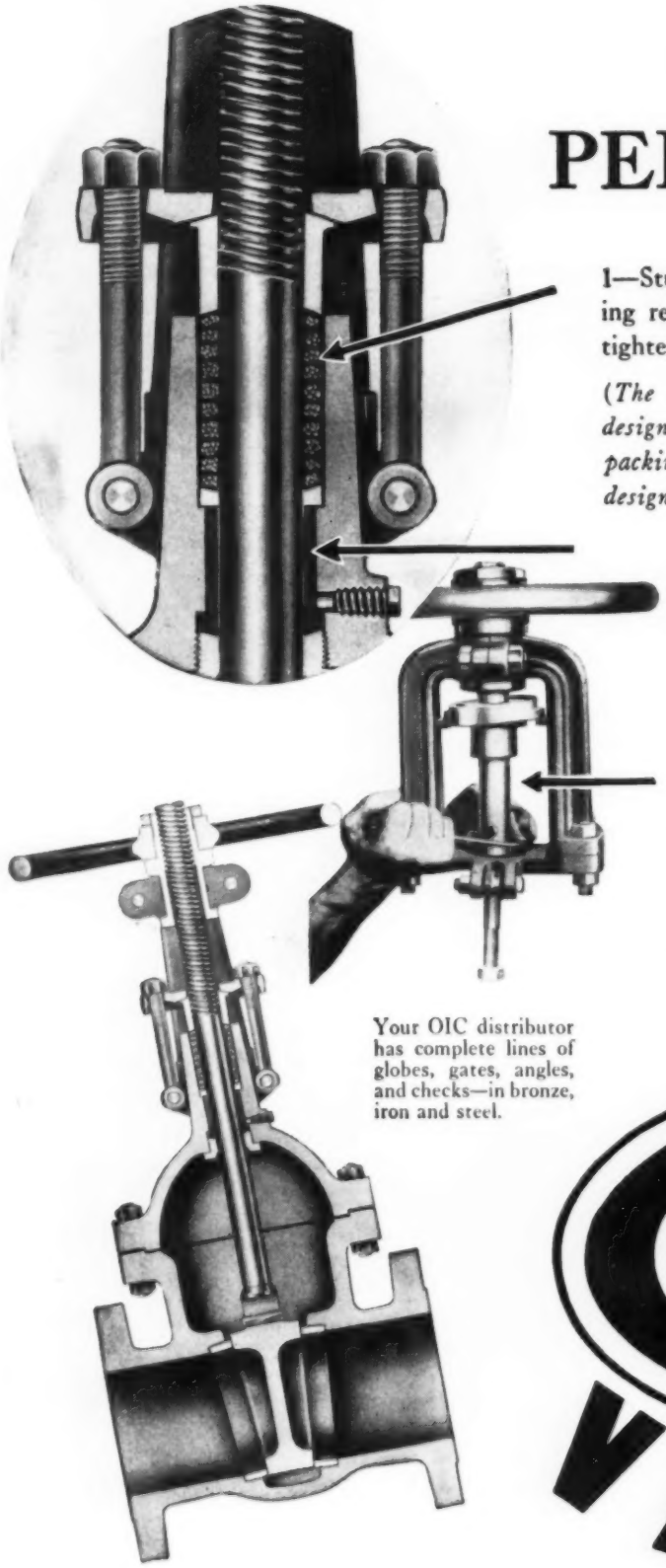
Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

THE MARK OF TECHNICAL EXCELLENCE IN SYNTHETIC RUBBER

THE WORLD'S LARGEST MANUFACTURER OF V-BELTS

How OIC *Improves* VALVE PERFORMANCE



1—Stuffing box is especially designed so that packing retains life and resilience as the packing nut is tightened from time to time.

(*The equalized compression provided by the special design of OIC packing glands can lengthen the life of packing as much as 10 to 20 per cent compared to other designs.*)

2—For installations where heat is an enemy of packing life a condensing chamber below the stuffing box minimizes heat deterioration.

(*Condensing chamber design is a special feature of OIC Valves for applications involving high temperatures.*)

3—Simplified repacking eliminates lost motion, reduces time required for repacking when needed.

(*The LIFT-LOK, exclusive with OIC, is a self-contained feature which automatically holds gland and follower out of the way while the valve is repacked.*)

Your OIC distributor has complete lines of globes, gates, angles, and checks—in bronze, iron and steel.

OIC VALVES

THE OHIO INJECTOR COMPANY, WADSWORTH, OHIO

6 ADVANCED ENGINEERING FEATURES PROVIDE EVEN FUEL DISTRIBUTION, PERFECT COMBUSTION, LOW OPERATING AND MAINTENANCE COSTS

1. **UNIT TYPE ELECTRO-HYDRAULIC DRIVE**—This type drive is an outstanding achievement in stoker design. One simple, compact mechanism—all self-contained—eliminating pipes, valves, fittings, shear pins, gears and other parts that usually leak, break, or give trouble. All moving parts are enclosed and operate in a bath of oil. Easy to keep clean. Absolutely protected against breakdowns should tramp iron and other foreign matter be fed in with the coal. Steam Drive Available.

2. **INTERVAL TIMER GOVERNOR (Patented)**—Standard equipment on all "F & E" Underfeed Stokers. Revolutionizes the feeding of coal by regulating the *time interval* between ram strokes, allowing the ram to operate FULL-STROKE, FULL SPEED at all times—a necessity in the efficient operation of an underfeed stoker. With this Governor, the operator can secure the *exact* rate of coal feed he desires.

3. **EXTERIOR FUEL BED REGULATOR**—The "F & E" Coal Distribution Regulator makes possible the regulation of the burning fuel bed from the OUTSIDE of the stoker in event of change in grade of coal . . . a further assurance of even distribution of fuel over the entire grate surface at all times.

4. **SLIDING BOTTOM RETORT**—Produces perfect underfeed action of the fuel from one end of the retort to the other. It is practically immune to distortion should the fire burn down into the retort.

5. **HIGH EFFICIENCY TUYERES**—Scientifically designed to produce efficient preparation and burning of fuel. Extremely large heat-radiating surfaces result in low maintenance.

6. **RENEWABLE RAM CASE LINER**—Ram operates in a steel liner fitted to the interior of the ram case. When wear results, original size can be restored quickly and economically by replacing the ram and liner. Another "F & E" feature designed to facilitate keeping the stoker always in best operating condition with a minimum of effort, expense and time.

This 6-FEATURE COMBINATION IS AVAILABLE ONLY IN "F & E" UNDERFEED STOKERS

Get in touch with the "F & E" representative in your locality or write direct to manufacturer for literature and case histories of what "F & E" Stokers have accomplished for others. Ask for Bulletin 1105.

FLYNN & EMRICH CO.

Established 1842

Holliday & Saratoga Sts., Baltimore 2, Md.

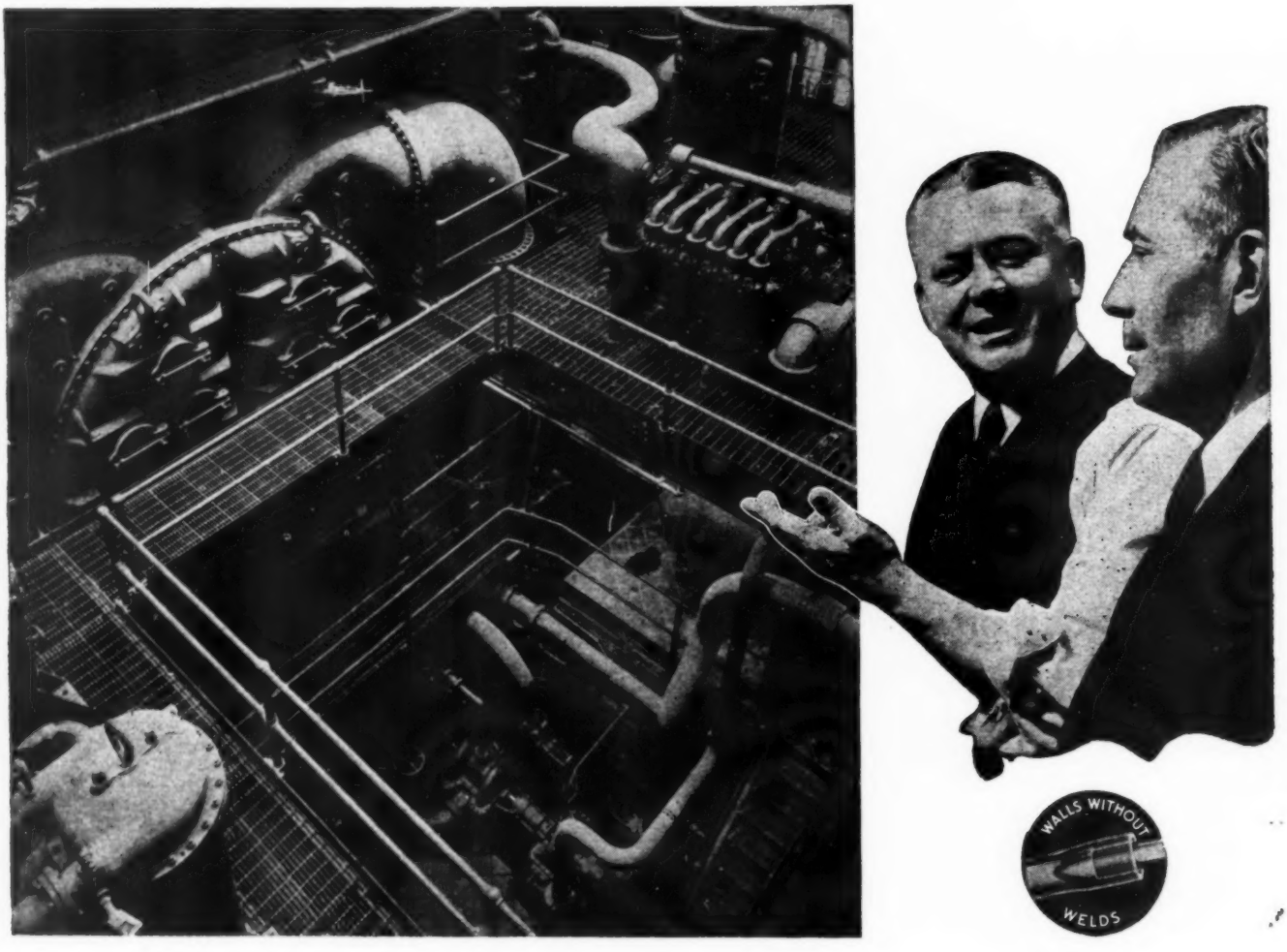
Representatives in Principal Cities

F&E UNDERFEED STOKERS

Bituminous and Anthracite Types—For Heating or Power Boilers Producing from 1,000 to 40,000 lbs. of steam per hour

BECAUSE— Seamless stands for Safety

FAR-SIGHTED ENGINEERS PREFER U·S·S NATIONAL



WHEN you're dealing with high temperatures and high pressures, why take chances? Standardize on U·S·S NATIONAL Seamless—the *safest* pipe ever developed for critical power plant service.

To seasoned power plant designers and operating engineers, "Walls Without Welds" are three words that have come to stand for the finest in industrial piping. They mean dependable long-life pipe that has for many years demonstrated its outstanding ability to resist the severest conditions of temperature and pressure. Pipe that's pierced from solid billets of high quality steel. Pipe with no line of potential weakness to limit safe operating pressures. Pipe that can be trusted without reservations to do the job—NATIONAL Seamless.

NATIONAL Seamless has inherent safety to recommend it. Every length is a homogeneous, soundly formed cylinder with full wall strength, accurate in dimensions, and uniform in physical properties. Every length is carefully tested and inspected to required specifications.

When ordering seamless pipe, be sure to say NATIONAL Seamless and secure America's Preferred Seamless Pipe for power plant service.

NATIONAL TUBE COMPANY · USS STEEL · UNITED STATES STEEL

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

UNITED STATES STEEL

New PREHEATER CATALOG!

The first section of the new Ljungstrom Air Preheater catalog is just off the press. Your copy will be on its way if you'll just fill in the coupon, and mail it.

THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. Plant: Wellsville, N. Y.

Please send me my free copy of the new Ljungstrom catalog.

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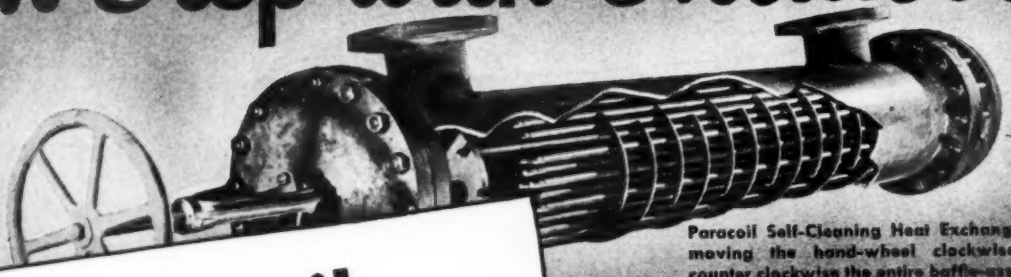
In Step with Industry



Paracoil Self-Cleaning Heat Exchanger. By moving the hand-wheel clockwise and counter clockwise the entire baffle-assembly is moved back and forth over the heating surface thus scraping any deposits from the tubes. Cleaning action is positive and effective. Ideal for heating fuel oil and other fouling liquids.

Paracoil

HEAT TRANSFER EQUIPMENT

Davis Engineering Corporation has played a major part in the development, design betterment and manufacture of distillation, evaporation and heat exchange equipment for more than 30 years.

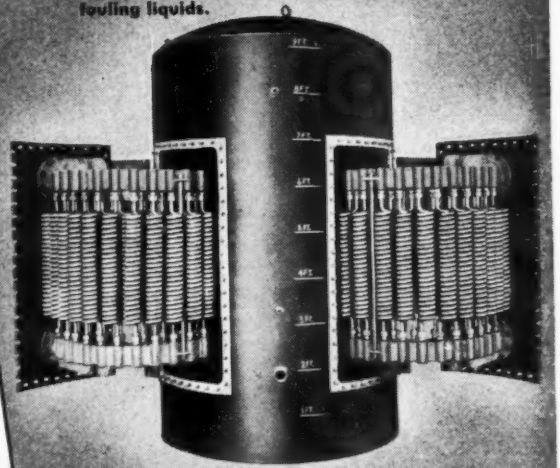
Pictured are Paracoil Heat Transfer units designed to serve America's industries as well in peace as they served the country during the war. Davis built heat exchangers assure greater production efficiency, reduced repair and cleaning costs and freedom from shutdown losses.

Paracoil equipment is available for practically every type of heat transfer application called for by our many and varied industries.

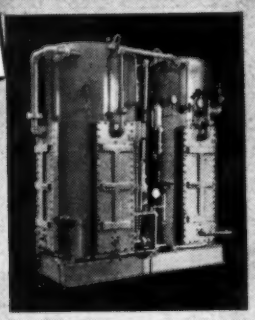
Technical and practical knowledge accumulated from 30 years of manufacturing experience and job performance, supplemented by continuous engineering research, have resulted in fundamental design improvements effecting advanced performance and increased resistance to severe service conditions.

Whether yours is a replacement, new, or more efficient equipment need, Paracoil Heat Exchangers are available on most reasonable delivery schedules and Davis engineers are ready to assist in making proper selection of size and design best suited for your particular problems.

To those with fouling problems: Write for bulletin HE-100 describing the Paracoil Self-Cleaning Tubular Heat Exchanger.

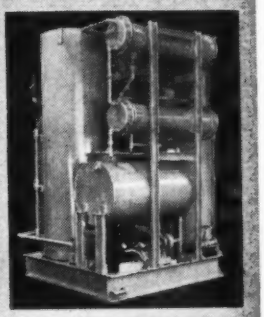


Paracoil Double-Door Evaporator. Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in single and multiple effects and in a wide range of capacities.



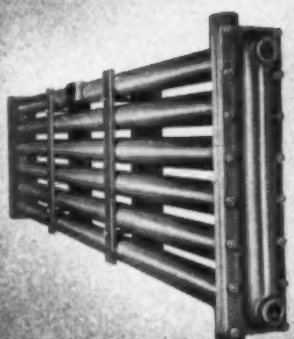
FRONT VIEW

Triple Effect Package Type Distillation plant built for supplying distilled water from sea water or contaminated water for drinking and process service. Illustrates Paracoil hinged door evaporators. A completely self contained unit.



BACK VIEW

This distillation unit has a capacity of 180 gallons per hour with low pressure steam and economical steam consumption. Other package types standardized for a number of capacities.



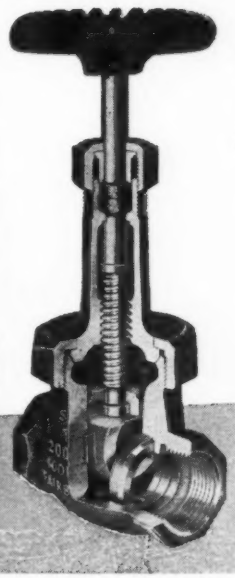
Gas to Gas Heat Exchanger. This type of Paracoil Heat Exchanger has many industrial uses for transfering heat between gases or liquids, or between gases and liquids. Unit illustrated constructed entirely of Inconel. Can be furnished in other alloys or carbon steel.

Liquid to Liquid Exchanger. Special liquid to liquid exchanger for counter current flow, six pass on both shell and tube sides. Most efficient design for crossing temperature conditions. Straight tubes easily cleaned.

SINCE 1915
Paracoil
HEAT TRANSFER EQUIPMENT

DAVIS ENGINEERING CORPORATION
1066 EAST GRAND STREET, ELIZABETH 4, NEW JERSEY

high-value highlights of the fairbanks bronze valve line



MANY VALVES FOR MANY SERVICES can be selected from the broad range of Fairbanks Bronze Valves highlighted here. Made for pressures from 125 to 300 pounds, Fairbanks Valves are available with screwed or flanged ends also with Faircoseal ends for Silbraz joints.

The Fairbanks distributor performs **many services for many industries.** Adequate stocks of all types of piping and mill supplies as well as Fairbanks Valves are available as needed, day or night.

Consult your distributor for all valve installation requirements.

Fig. 0236
200 Pound UNION BONNET BRONZE GATE VALVE
Rising stem — renewable nickel alloy seat and wedge.

The superior hardness and corrosion-resistance of nickel alloy wedge and seats, in addition to the sturdy hexagonal union nut, with radial body bonnet joint make this new valve particularly adapted to long, satisfactory service, with low maintenance cost. Also available in non-rising stem type and with integral seats.

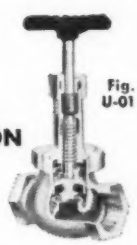


Fig. U-01
COMPOSITION DISC Globe and Angle

Union bonnet — integral seats — 150 and 200 pound pressures. For services requiring quick disc renewal.

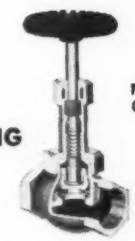


Fig. 033
REGRINDING Globe, Angle and Cross

Bronze disc—integral seat—union bonnet—200 and 300 pound pressures. For higher pressure service where composition discs are not satisfactory.

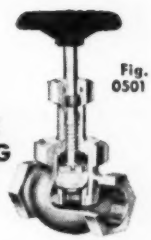


Fig. 0501
RENEWABLE REGRINDING Globe and Angle

Nickel alloy seat and disc—union bonnet—200 and 300 pound pressures. For more severe services on steam, water, oil, gas and air.

Fig. 0501-P
PLUG DISC AND SEAT Globe and Angle

Renewable hardened nickel alloy seat and disc—200 pound pressure. For throttling and other service requiring close regulation of flow.

Fig. 0250
NON-RISING STEM Gate Valves

Screwed bonnet — solid wedge — taper seat 125, 150 and 300 pound pressures. For full flow of steam, water, oil and gas.

Fig. 0228
RISING STEM Gate Valves

Screwed bonnet — split wedge — solid wedge for 125 and 150 pound pressures. For steam, water, oil and gas.

Fig. 0209
OUTSIDE SCREW AND YOKE Gate Valves

Screwed bonnet — solid wedge — taper seat — 150 and 300 pound pressures, where operating threads must not contact fluids.

Fig. 0230
UNION BONNET Gate Valve

Non-rising stem — nickel alloy wedge—integral seat—200 pound pressure. For higher pressures on steam, water, oil and gas.

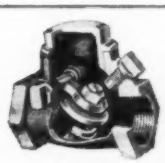


Fig. 0601
SWING CHECK VALVES

Horizontal—renewable bronze disc—125, 150, 200 and 300 pound pressures. For maximum flow of steam, water, oil and gas.

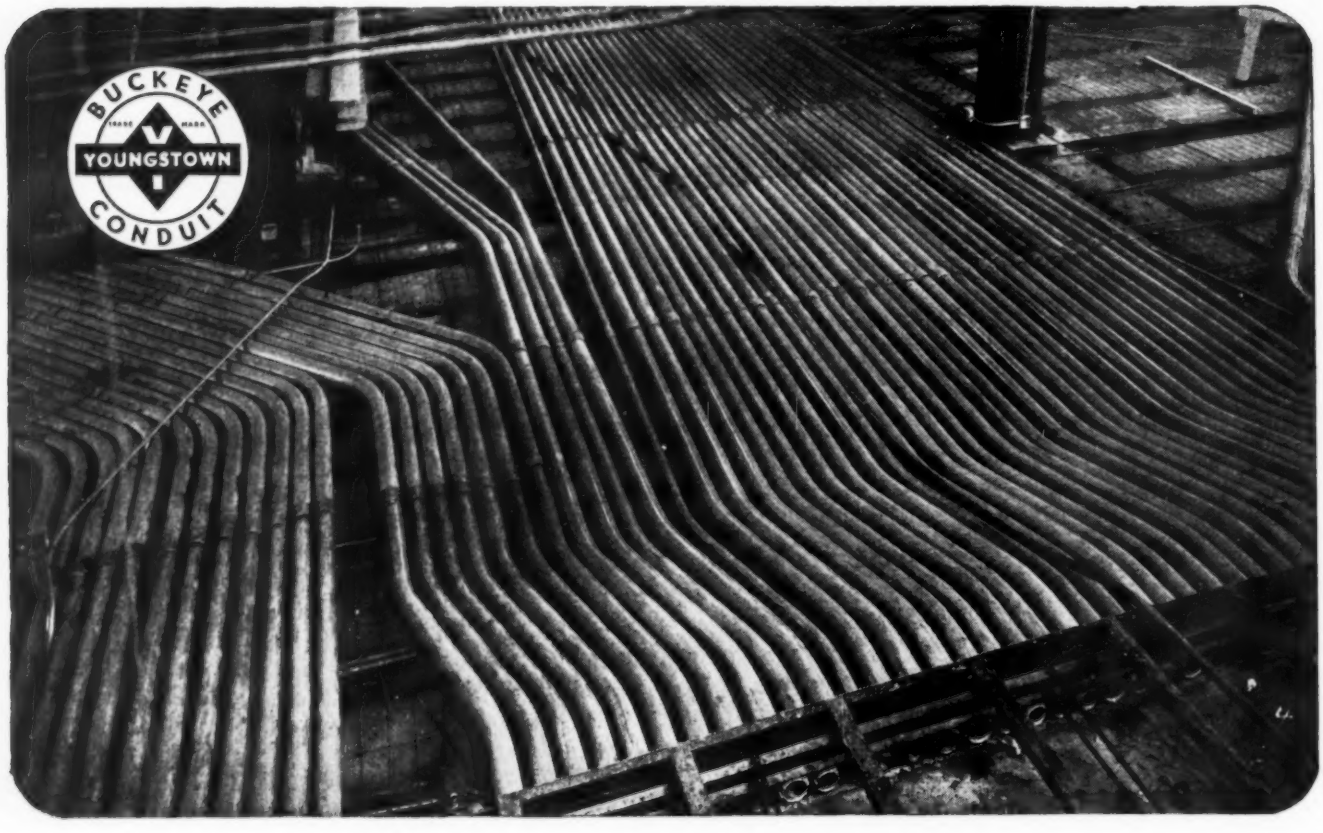
Fig. 0616
LIFT CHECK VALVES

Horizontal—angle. Renewable composition disc for 150 pounds —regrinding bronze disc for 200 and 300 pounds. To prevent return flow. Positive vertical lift of discs.

American industry flows through fairbanks valves

Write for further information on the types of valves required or ask for Catalog "42". The Fairbanks Company, 393 Lafayette Street, New York 3, N. Y., also Boston 10, Mass., Houston 2, Texas, and Pittsburgh 22, Pa.

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*



When you say "BUCKEYE CONDUIT"

you're talking Wiring Safety

FOR many years Youngstown "Buckeye" has been the most widely used rigid steel conduit in the world. It is a standard-threaded, heavy wall conduit, properly finished inside and out for maximum wiring protection and efficient installation and service. In every respect it meets the rigid requirements of the industry, as expressed in the National Electrical Code. More than a quarter century of service under the most severe conditions has demonstrated that it is thoroughly dependable.

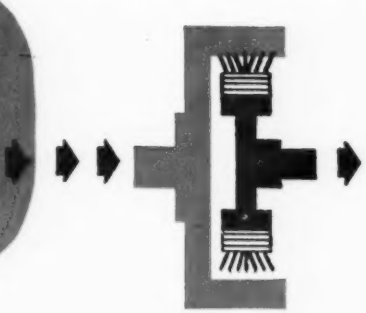
So specify and install Youngstown "Buckeye" wherever you want positive wiring safety. It is now available through leading distributors in every industrial market. For their names and for other information on conduit, write, phone or wire our nearest District Office.

Ask your distributor for:
Youngstown Buckeye Conduit...Pipe and Tubular Products...Sheets...Plates...Electrolytic Tin Plate...Coke Tin Plate...Bars...Rods...Wire...Tie Plates and Spikes.

YOUNGSTOWN
THE YOUNGSTOWN SHEET AND TUBE COMPANY
GENERAL OFFICES - YOUNGSTOWN 1, OHIO
Export Offices - 500 Fifth Avenue, New York City
Manufacturers of
CARBON - ALLOY AND YOLOY STEELS

THE MODERN

Answer



To These Drive Problems··· *Calling for Adjustable Speed Control*

Today's answer in getting economical, adjustable-speed control for boiler draft fans, centrifugal pumps and centrifugal compressors is the E-M Adjustable-Speed *Magnetic Drive.*

The Magnetic Drive is a simple, compact electro-magnetic torque transmitter. It is installed between a squirrel-cage or synchronous motor and the driven equipment, and operates in combination with an electronic controller to maintain selected speed regardless of changes in load. The Magnetic Drive requires no fluids; is simple, rugged and clean; provides precise, microstep speed control over a wide range with immediate response to load requirements.

Boiler draft fans are the outstanding application for Magnetic Drives, but the inherent features of the unit are also highly advantageous on all applications characterized by a load torque which drops off rapidly with reduction in speed, such as centrifugal pumps, centrifugal compressors and blowers.

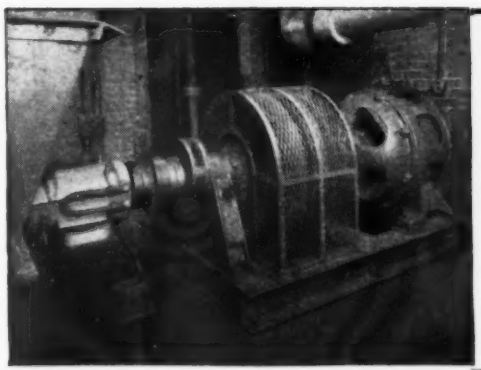
Write now for Publication No. 183, describing E-M Magnetic Drive construction, operation and advantages.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

E-M

MAGNETIC DRIVES

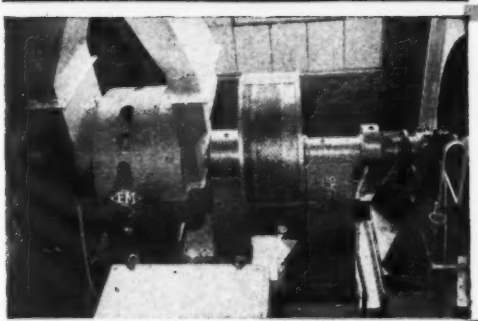
PRECISE, WIDE-RANGE, QUICK-RESPONSE SPEED CONTROL A2034



Answer 1

INDUCED DRAFT FANS

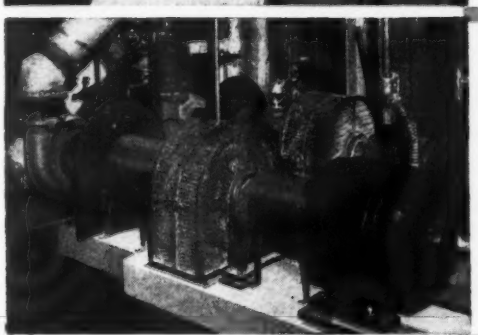
Wide-range, precise boiler draft control on an induced draft fan at a New Jersey paperboard company was provided when this 100 hp, 870/87 rpm, E-M Magnetic Drive unit replaced a slip-ring induction motor previously used.



Answer 2

FORCED DRAFT FANS

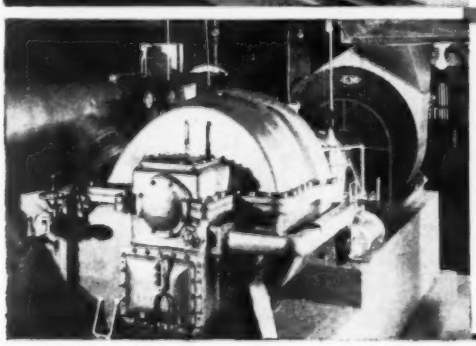
Quick-response, adjustable speed control of forced draft fan at an Ohio power plant is provided by this 322 hp, 1145/280 rpm E-M Synchronous Motor-Magnetic Drive set. Induced draft fan also uses an E-M Magnetic Drive.



Answer 3

CENTRIFUGAL PUMPS

Two 40 hp, 1707/1056 rpm, E-M Magnetic Drives in a Wisconsin paper mill drive black liquor centrifugal pumps feeding boilers. Magnetic Drive is a compact unit installed between motor and pump to control fluid delivery rate.



Answer 4

CENTRIFUGAL COMPRESSORS

Close-regulated, adjustable speed to suit refrigeration requirements for air conditioning in a Florida mercantile building is provided on this centrifugal compressor by an E-M 350 hp, 1150/840 rpm Magnetic Drive.

Packed WITH INFORMATION

WANT FACTS on packings and gaskets for maintenance? Want ideas? Call your local R/M distributor. He can help you keep presses, valves, pumps and other equipment packed right.

The new 1946 R/M catalog is just off the press . . . revised, enlarged . . . full of information and photographs on the expanding R/M line.

The R/M Distributor who will bring you your copy is our representative in your area. That means he is an expert on packing problems. Located near you, with an adequate stock to take care of your needs, he will give you prompt, efficient service.

Call your local R/M distributor for specialized, personalized packing service, fitted to your needs. Ask him for a copy of the new R/M catalog.

RAYBESTOS R M MANHATTAN

***It's "Packed with Satisfaction" when you use* R/M**

RAYBESTOS-MANHATTAN, INC.

ASBESTOS TEXTILE AND PACKING DIVISION

Manheim, Pa. · Bridgeport, Conn. · North Charleston, S. C. · Passaic, N. J.

THE BURNER that makes a new Boiler EASIER TO BUY

Thorough, accurate mixing of fuel and air . . . complete combustion . . . with Coppus-Dennis FANMIX

When planning new gas or oil fired boilers, you can count on investing less in boiler, stack and auxiliary equipment — if you select a Coppus-Dennis FANMIX Burner. Coppus equipment was used for instance in 93% of 191 petroleum refinery plants built for war use.

FANMIX Saves Combustion Space

FANMIX delivers to the furnace a homogeneous mixture of fuel and air, without blow-torch action. Combustion is rapid and complete — so smaller combustion space is needed than when the furnace must serve as mixing chamber as well — or ratings of present equipment can be increased.

FANMIX Creates Own Forced Draft

Less furnace draft is needed than with any other burner, because FANMIX creates its own forced draft, thus overcoming draft loss across the burner (at any operating range). Less stack is needed, and forced draft equipment can be eliminated entirely.

There are two FANMIX types—one to handle natural gas, the other a combination type to burn either gas or oil in entirety or gas and oil in any proportion. (No oil guns needed).

Coppus engineers FANMIX Burners for individual applications. Complete control over rate of combustion or "flame pattern" can be provided to meet the requirements of any installation. Coppus Engineering Corporation, 407 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

New Bulletin Will Help You When Installing New Equipment or Modernizing Old

ANOTHER
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There's a Brighter Spot in Your Coal Picture

with

AMERICAN RING CRUSHERS

More Efficient Coal Preparation

Because of diminished production, coal piles may not be normal for some time to come. To help offset this condition proper reduction of coal to uniform sizes is important. Control of fines and no oversize makes each ton go farther. The uniform reduction of American Rolling Ring Crushers reduce the waste of unwanted fines and eliminate oversize.

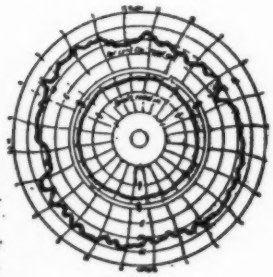
Greater Combustion Efficiency . . .

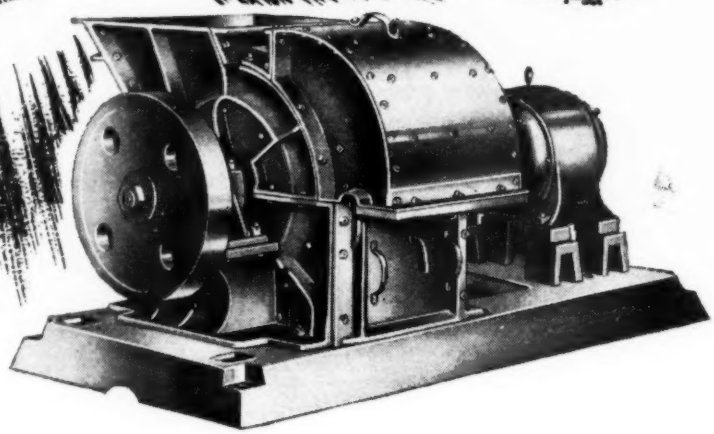
For the greatest possible BTU yield per pound of coal from available grades in your field . . . uniform reduction is essential.. All grades of coal are reduced to a uniform product from ROM or lump by American Rolling Ring Crushers. The uniformly crushed product results in reduced CO2 loss from excess air and reduced ash pit loss.

Low Cost Operation . . .

With the uptrend in fuel prices and operating costs, the extremely low operating cost of Americans effect savings that help offset other cost increases. The total operating cost of Americans is less than 1c per ton.

Graphically illustrating increased ash pit loss and low combustion efficiency resulting from improperly prepared coal, the CO2 chart below emphasizes the need for proper coal sizing such as Americans give.





Only Americans have the patented Manganese Shredder Rings that split coal instead of crushing it. Each ring has 20 cutting edges that is free to swing by centrifugal force. It deflects upon contact with tramp metal and eliminates the need for shear pins and other conventional safety devices.

The American Rolling Ring Type "S" Crusher, shown above, has set a high standard for efficient fuel sizing and crushing. Dependable, economical service is a certainty with an American. Low power demand, minimum maintenance and a high rate of operating efficiency are factors that assure lowest operating cost. Custom-built, there's an American to fit your specific job requirements.

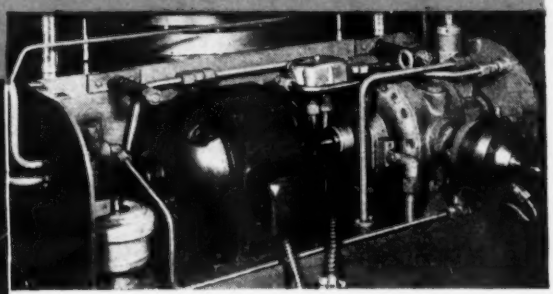
Write for bulletin "Crushing Coal at Less Than One Cent a Ton."

American PULVERIZER COMPANY

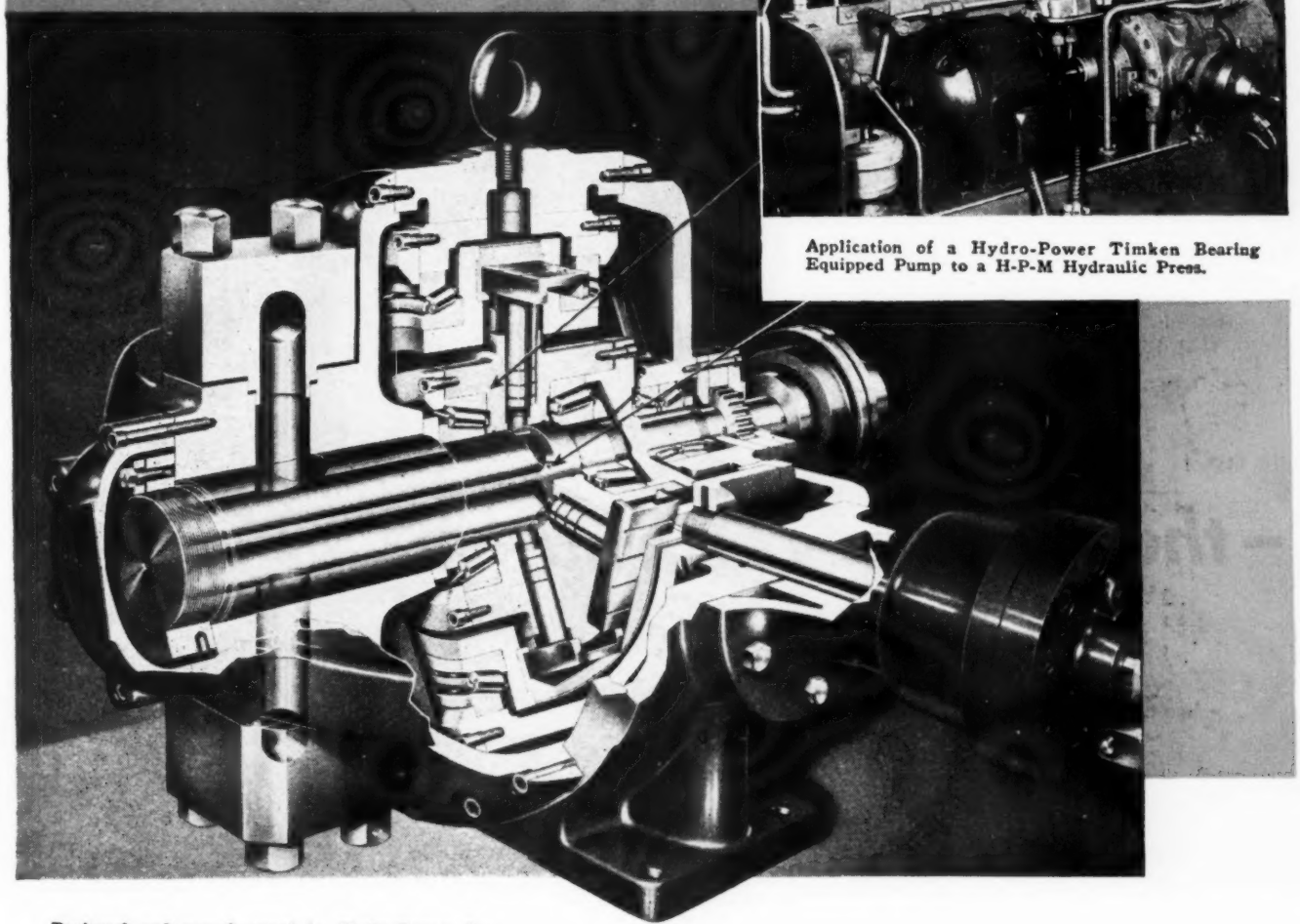
Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Avenue
St. Louis 10, Mo.

A dependable SOURCE OF HYDRAULIC POWER



Application of a Hydro-Power Timken Bearing Equipped Pump to a H-P-M Hydraulic Press.



Designed and manufactured by Hydro-Power, Inc., Springfield, Ohio.

There's nothing like hydraulic power for many purposes, but its efficient, economical application depends upon the source — the pump that generates it.

The Hydro-Power Radial Hydraulic Pump operates at high and constant volumetric efficiency largely because the minute working clearances between the high-speed rotor (A) and stationary valve pintle (B) are positively maintained at all times.

This is achieved by mounting both rotor and valve pintle on Timken Tapered Roller Bearings of extreme precision as shown in the sectional illustration. Besides preserving the original operating clearance, these Timken Bearings eliminate rotor friction and provide full protection against radial, thrust and combined loads — therefore greater endurance.

Should a slight amount of wear develop after years of service, the bearings can be adjusted with hair-splitting accuracy without dismantling the pump or even removing it from the machine. To be sure of getting genuine Timken Bearings, look for the trade-mark "TIMKEN" on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

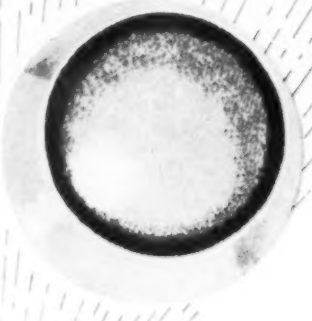
TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

PICTURE OF A CASTING FAILURE

—that will never happen!



• There's a deeply hidden flaw here —an imperfection that might cause trouble later if it went undetected now.

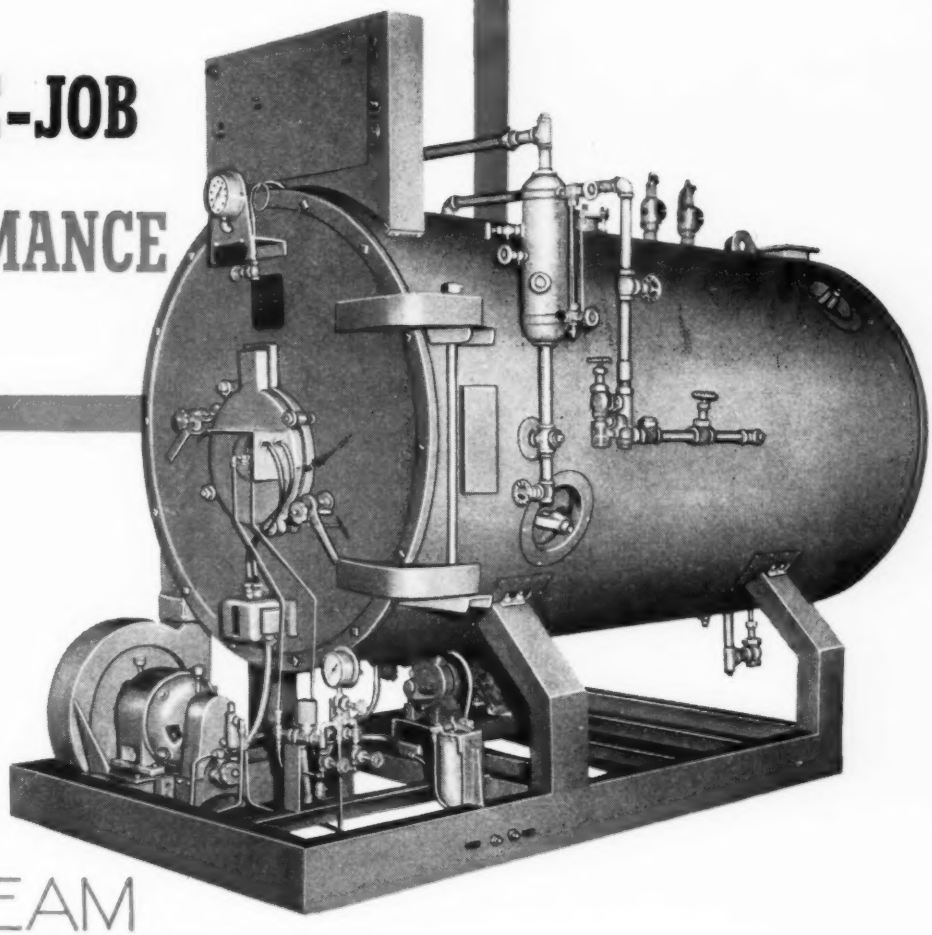
A Sivyer radiographic picture caught it. Now it can never wear the Sivyer diamond ◈ —for this is the mark of sound castings.

In other ways, too, Sivyer steel castings must pass the test. They must possess close dimensional accuracy . . . be true to pattern contour and shape . . . have an extra degree of finishing for less processing on your part.

These are the reasons critical buyers specify Sivyer castings for more satisfactory, more lasting service.

SIVYER STEEL CASTING COMPANY
MILWAUKEE ◈ CHICAGO ◈

ON-THE-JOB PERFORMANCE



AMESTEAM GENERATOR

The AMESTEAM Generator is designed to operate at a guaranteed efficiency of 80%, not just under test conditions, but *daily* in your own plant.

In addition, we have designed the units to provide simplicity of operation and maximum accessibility of all parts for inspection, cleaning or maintenance.

Standard AMESTEAM Generators are available for operation with the most economical fuel oil or gas in your locality.

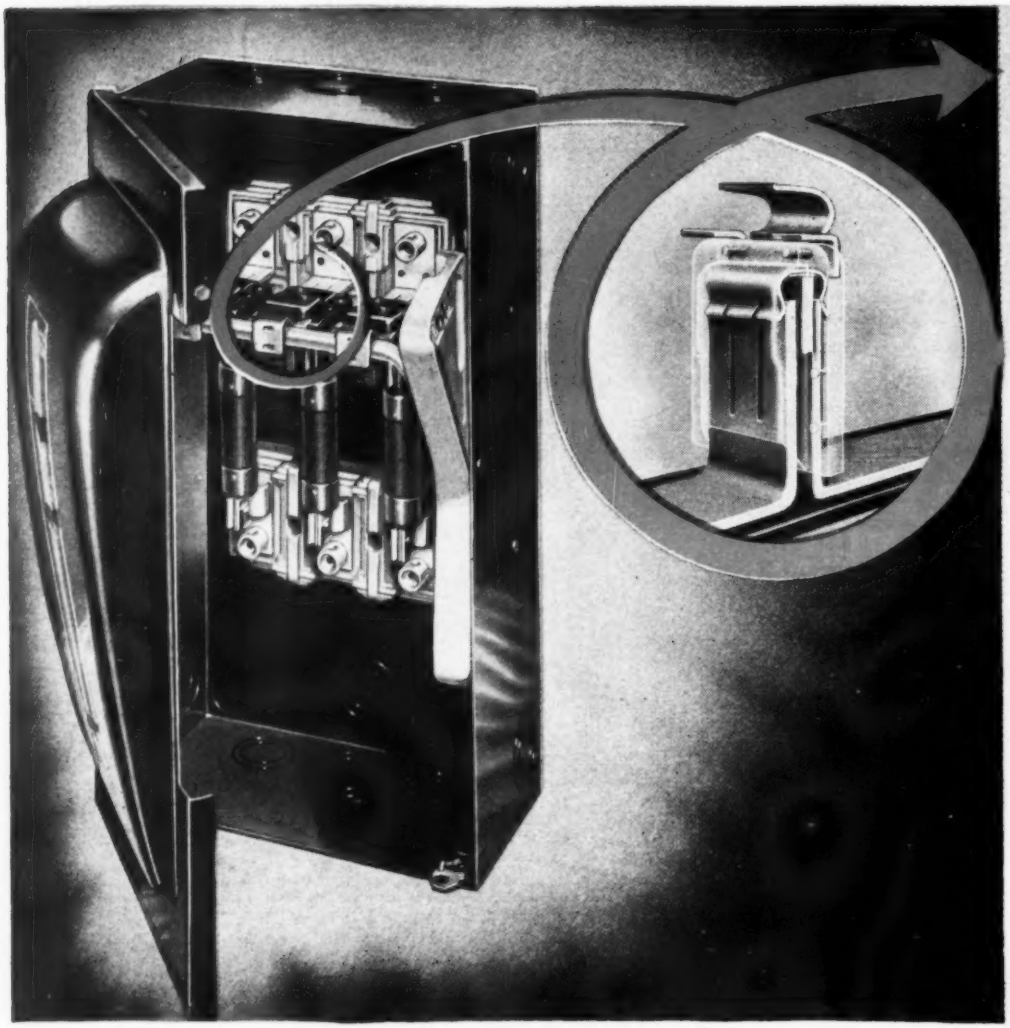
We invite your investigation of any of our existing installations throughout the World, or will welcome you at our plant where you may see every phase of the construction and test of the unit.

A letter, wire or phone will bring you a list of installations in your vicinity.

A complete return-to-the-boiler system, including Feed Water Pump and Condensate Tank with their accessories, is part of the standard equipment with every standard AMESTEAM Generator.

AMES IRON WORKS
BOX 67 OSWEGO, NEW YORK

Less arcing...longer life...



WITH BULLDOG *Vacu-Break* SAFETY SWITCHES

SAFETY SWITCHES are the guardians of electric circuits. They keep power on the job. That's why you'll want to weigh the advantages of BullDog Vacu-Break Safety Switches—for today and for the years to come.

There are six plus values in Vacu-Break Safety Switches—six exclusive design features to make them ideal productive devices for trouble-free operation under heavy production schedules.

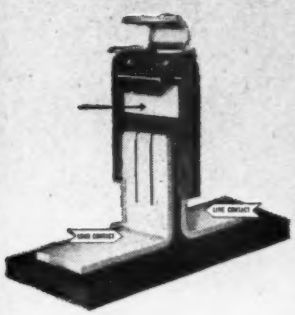
1. Less arcing and resultant longer life, because BullDog's formed "Bakelite Arcing Chambers" confine and suffocate arcs to prevent burning and pitting of contacts.
2. "Clampmatic" switch contacts, providing "clamp type pressure" when contacts are closed—quicker, easier release when the handle is thrown to the OFF position.
3. Quick action mechanism assures positive "ON and OFF" operation with a minimum number of wearing parts.
4. Ample wiring room is provided without sacrificing compactness.
5. Solderless wire grips.
6. Streamlined handle placed within the cabinet lines to allow front operation and closer banking of switches.

BullDog Vacu-Break Switches—first in quality and first in safety—keep power on the job to help you speed production and reduce maintenance costs. Get full information now—either by consulting a BullDog field engineer or by writing us for descriptive folders.

• • •

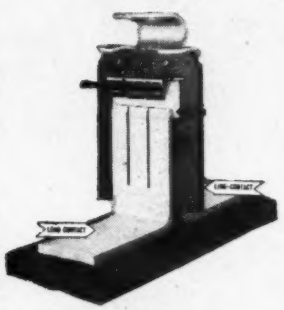
Manufacturers of SafToFuse Panelboards—Switchboards—Circuit Master Breakers—BUStribution DUCT for "plug-in" power—Universal Trol-E-Duct for flexible lighting—Industrial Trol-E-Duct for Portable Tools, Cranes and Hoists.

EXCLUSIVE *Vacu-Break* AND CLAMPMATIC CONTACT FEATURES



"CLAMPMATIC" SWITCH CONTACTS

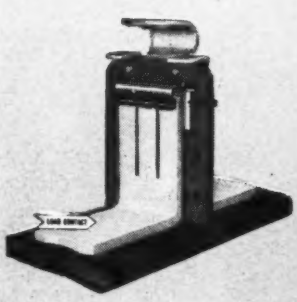
With formed Bakelite cover removed, illustration shows moving contact confined within the slotted section of the arcing chamber, free to engage stationary contacts when switch is operated from "OFF" to "ON" position.



EASY MAKE AND BREAK

(Left) When operated to OFF position, clamping spring first releases its pressure to remove disconnecting resistance.

(Right) When operated to ON position, contact (slug) first engages stationary line and load contacts before clamping spring makes full pressure contact.



BOLT TIGHT CONNECTIONS

Moving contact (slug) is held tightly between line and load contacts by clamping pressure spring in full ON position.

BULLDOG
ELECTRIC PRODUCTS COMPANY

DETROIT 32, MICHIGAN. IN CANADA: BULLDOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO. FIELD OFFICES IN ALL PRINCIPAL CITIES

SAVE THE HEAT

that now takes Wing

1. Lower your fuel bill

•

2. Have larger boiler capacity

•

3. Cut maintenance

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

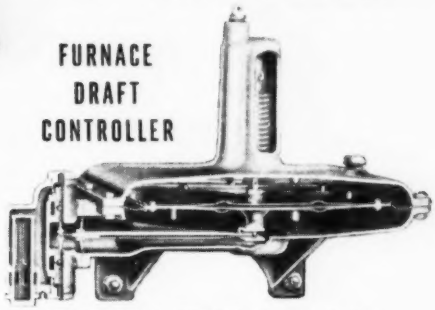
HEAT that is lost through the stack becomes that much waste in fuel and loss in boiler capacity. It doesn't match up at all with the economies you make in other departments. Whether you burn coal, oil, or gas you can have controlled combustion by simply installing a CASH STANDARD Automatic Combustion Control System. Then your fuel feed is controlled as well as is the air supply and a constant draft is maintained in the combustion chamber . . . more of the heat that is produced goes direct to the boiler water.

The net result is you get more steam from less fuel—you have a bigger boiler than previously because it produces more steam at less cost.

Send for Bulletin No. 300

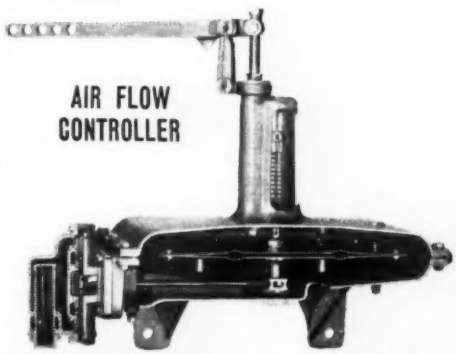
To find out the full details read about the application of this system and the various combinations of units possible to meet all conditions and that work on any boiler or stoker with any kind of fuel.

FURNACE DRAFT CONTROLLER

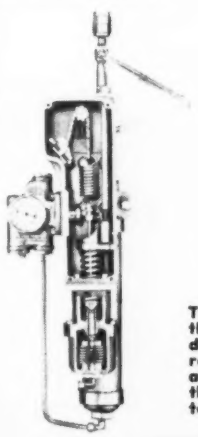


This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

AIR FLOW CONTROLLER



This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



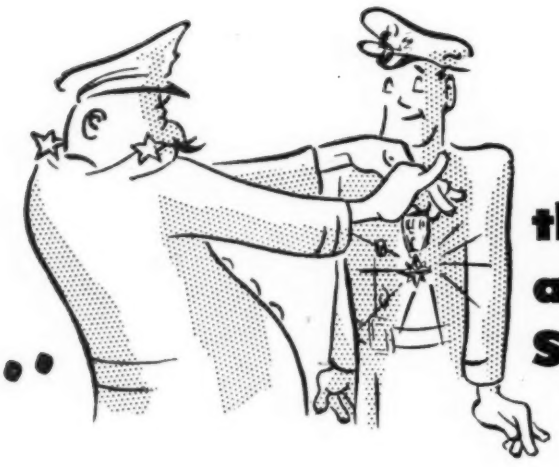
FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

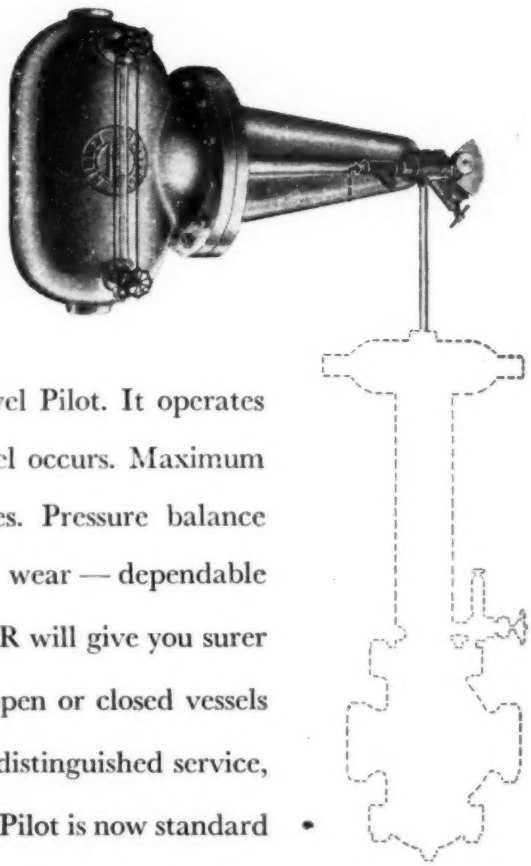
A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

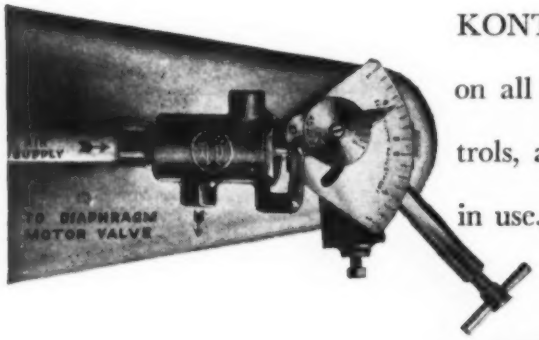
It's a sure bet...



this pilot will win a Distinguished Service Medal



Direct or reverse action by shifting an index pointer! Desired level set simply by rotating a disc! Sensitivity adjusted so that as little as 1" or as much as 8" change in level is required for full valve travel! These are a few of the service advantages of K & M's radically new KONTROL-MASTER Liquid Level Pilot. It operates on air — using air only when a change in level occurs. Maximum bellows movement plus or minus .010 inches. Pressure balance valve design automatically compensates for wear — dependable accuracy is maintained. KONTROL-MASTER will give you surer control in operating feed or drain valves on open or closed vessels — at less cost, with least attention. To assure distinguished service, KONTROL-MASTER Pilot is now standard on all Kieley & Mueller Liquid Level Controls, and may be installed on units already in use. Write for bulletin.



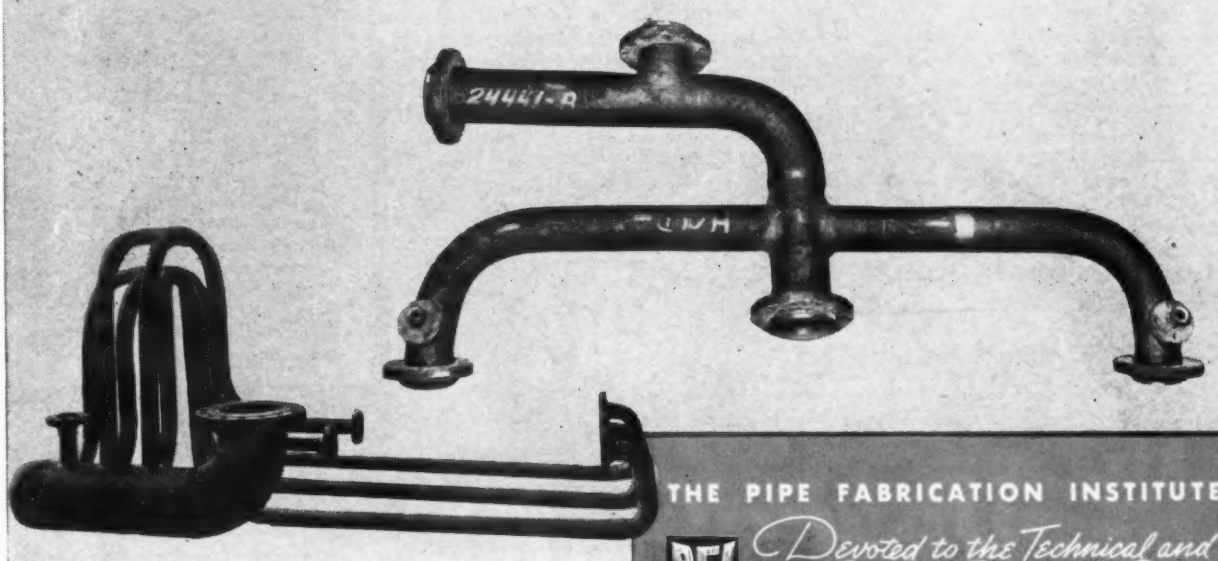
KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS SINCE 1879
NORTH BERGEN, NEW JERSEY

FOR BETTER PRESSURE PIPING *Use* PRE-FABRICATED PIPING

Pre-fabricated piping is delivered to the job as a series of subassemblies with all difficult operations performed in the fabricating plant . . . thus facilitating easy, rapid and economical installation. These subassemblies are commercially practical, heat treated and stress relieved when necessary, correctly aligned, thoroughly cleaned, shop tested, and inspected.

Pre-fabricated piping is prepared in plants equipped with considerable special machinery and staffed by highly skilled organizations. Much of this specialized equipment is not readily available in the field. The qualified fabricator has an organization with long and varied experience in the practical possibilities and limitations of piping . . . can frequently contribute suggestions that simplify and improve piping layout, save time and reduce costs.

Pre-fabricated piping has many advantages for the user of pressure piping.



F-9

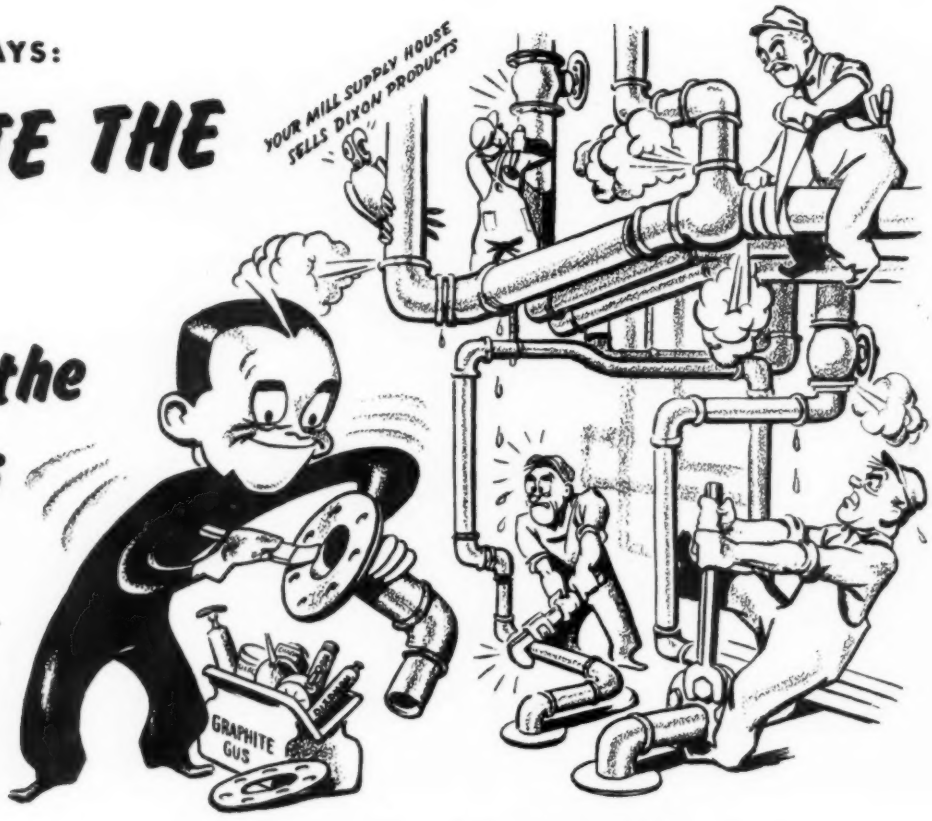
THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING PITTSBURGH, PA.

GRAPHITE GUS SAYS:

GRAPHITE THE "JOINT" and save the headaches



These two joiners take the aches out of putting up piping, taking it down and keeping it leakproof

DIXON'S PIPE JOINT GRAPHITE COMPOUND

This superlative lubricant and permanent seal leak-proofs all joints against hot or cold water, steam, air, gas, aqueous solvents, acids and brines. It assures easy, quick assembly. In dismantling—even years later—it saves damage to gaskets, fittings, valves, etc. Wherever you need extra precaution against joint-failure get this heat-proof, corrosion-proof, non-setting Graphite pipe joint compound and save backaches and headaches. Read Data Sheet #21.

DIXON'S GRAPHITE SEAL

Tested and approved by the Underwriters Laboratories, this seal makes permanent leak-proof connections on all varieties of pipe lines and assemblies conveying hot or cold oil, gasoline and petroleum gases. It solidifies quickly, but its lubricating flake graphite content makes assembly and dismantling practically effortless. This saves time and money on fittings, gaskets, valves, etc. Read Data Sheet #22.

DIXON'S GRAPH-AIR GUN TYPE 4

Handily blows its contents of dry powdered Microfyne Graphite into locks and all close-fitting mechanisms. Provides long lasting lubrication that is exceptionally resistant to extremes of temperature. In shop, office and home it's the most useful lubricator ever. Read Data Sheet #8 for many of its 1001 uses. Buy a gun at your Supply or hardware store—30¢.

DIXON'S DATA SHEET DIRECTORY
Add to Your Knowledge of Graphite and to your Reference File
DIXON'S ILLUSTRATED DATA SHEETS

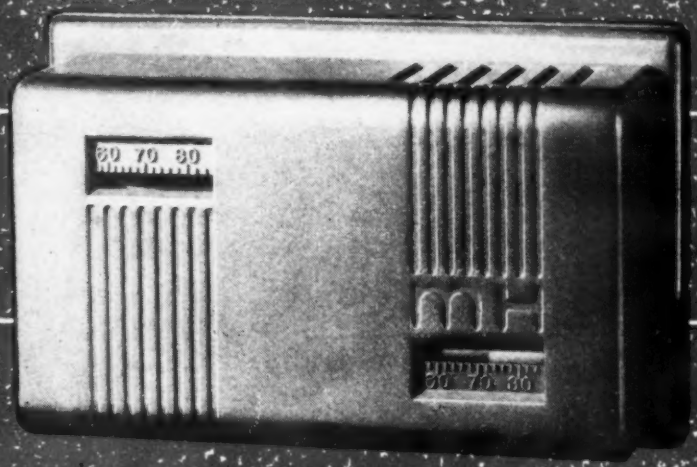
Valuable Graphite "Know-How" free for the asking! Write Graphite Gus today for Data Sheets No. 21, 22 or 8 and Dixon's illustrated Data Sheet Directory.

You will likely be amazed to also learn what the Complete Line of Dixon's Graphite Products has done for others, and can do for you.

YOUR SUPPLY HOUSE SELLS THE COMPLETE LINE OF DIXON'S GRAPHITE PRODUCTS

JOSEPH DIXON CRUCIBLE COMPANY

DIV. 94-C7 — JERSEY CITY 3, NEW JERSEY



WHY HORIZONTAL?

THE SUCCESS of any thermostat depends upon the free, uninterrupted passage of air across the entire surface of the temperature sensitive element.

In the Gradustat, Honeywell's pneumatic thermostat, this temperature sensitive element is mounted alongside of other mechanism which, were it above or below the element, would naturally retard the flow of air.

This exclusive Honeywell design permits absolutely free passage of air across the element and naturally results in far greater sensitivity and resultant accuracy of temperature control than conventionally mounted pneumatic thermostats.

For best performance with pneumatic control, it's always the horizontally mounted Honeywell Gradustat. And don't forget, the Gradustat is as modern in appearance as it is outstanding in accuracy. Minneapolis-Honeywell Regulator Company, 2607 Fourth Avenue South, Minneapolis 8, Minnesota. Branches and distributing offices in all principal cities.

MINNEAPOLIS
Honeywell
CONTROL SYSTEMS

For ease of bending, welding... and for long service—

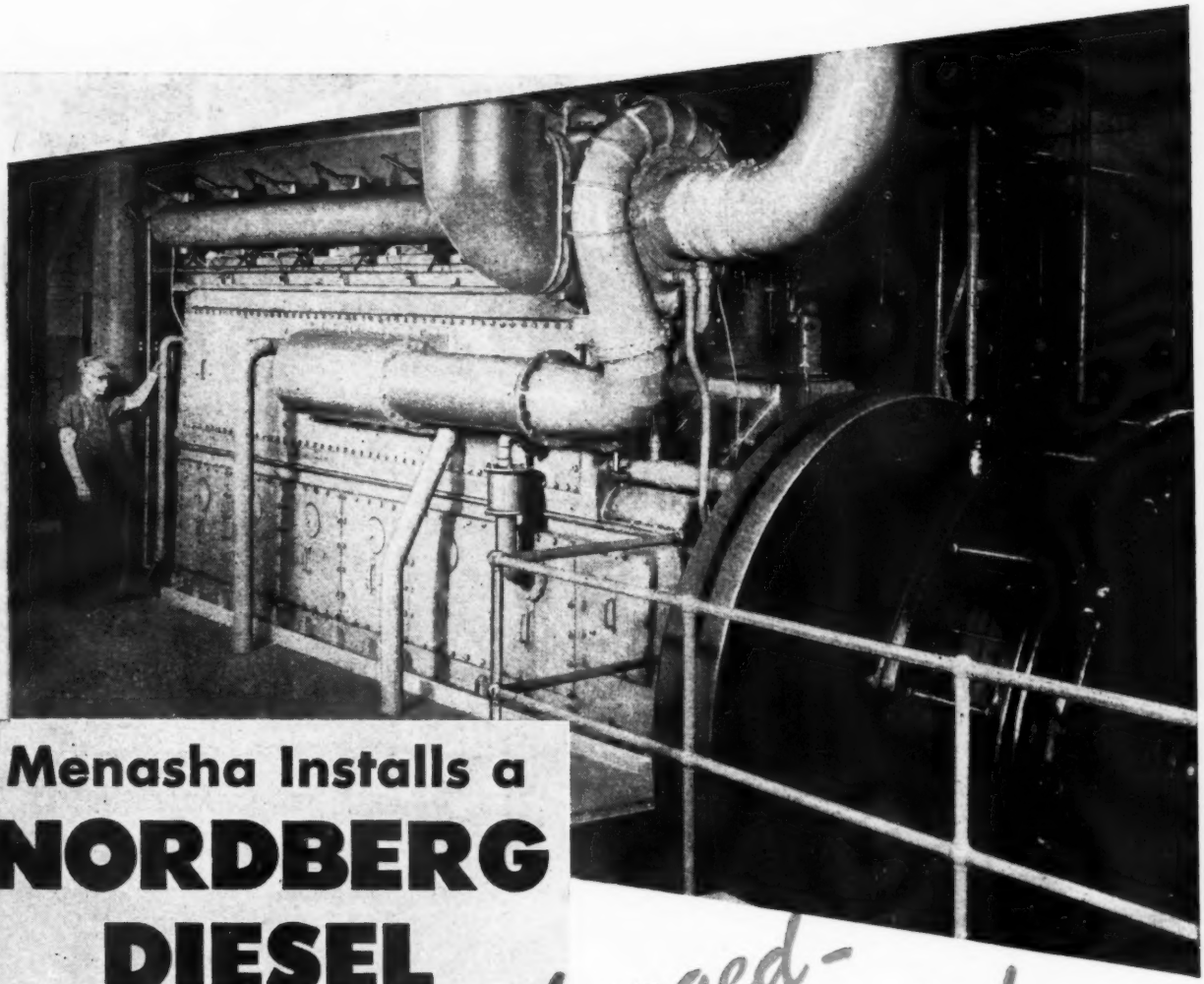
USE J&L STANDARD PIPE

J&L steel pipe is made of J&L Controlled Quality steel especially for bending and welding in power plant installations. The long experience and skill of J&L men enables you to obtain a pipe that has uniform wall thickness, is clean and straight for your most exacting installations. J&L steel pipe is made to give long and satisfactory service. Write for information.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PENNSYLVANIA

Z60



Menasha Installs a NORDBERG DIESEL

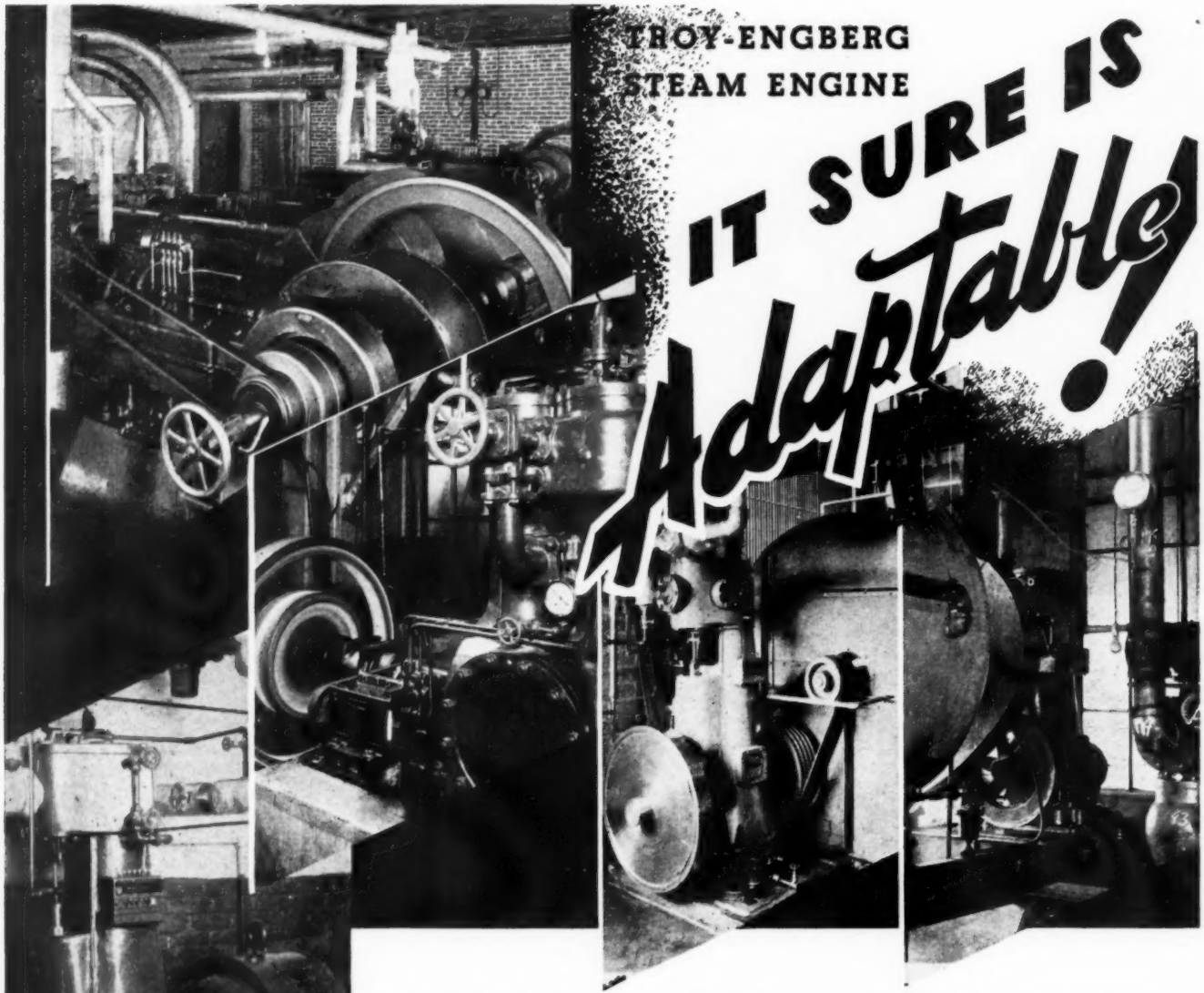
Supercharged-Intercooled

This recent installation in Wisconsin's oldest Diesel-engined municipal power plant is another Diesel achievement by Nordberg. In addition to supercharging, the suction air is cooled between the turbocharger and power cylinders by means of a built-in intercooler allowing still greater load carrying capacity...In order to utilize an existing generator it was necessary to operate the engine at 300 R.P.M. The engine rating is 1100 B.H.P. It is four-cycle, mechanical injection built in six cylinders.

If you are faced with a Diesel power problem, in need of additional generating capacity or contemplating a new power plant, let Nordberg engineers acquaint you with dependable, economical Nordberg Diesel power.

NORDBERG MFG. CO., MILWAUKEE 7, WIS.

NORDBERG DIESEL ENGINES



TROY-ENGBERG
STEAM ENGINE

IT SURE IS *Adaptable!*

An offhand check of the sales of Troy-Engberg Steam Engines shows quite a variety of equipment being driven. For example:

exhausters
pumps
draft fans
blowers
mixers
conveyors
generators
cookers
dryers
line shafts
air compressors
refrigeration compressors
ventilating fans

Probably *economy* and *dependability* provided the first two reasons why the steam engine was selected. Other reasons, however, were influencing factors: flexibility, close speed control, high starting torque; ability to carry heavy overloads for long periods, and in the case of some process plants, explosion-proof design.

The first two reasons—economy and dependability—should interest you in connection with that drive you are planning to buy.

Interesting information on the Troy-Engberg Steam Engine is given in our Bulletin 306. Send for a copy.

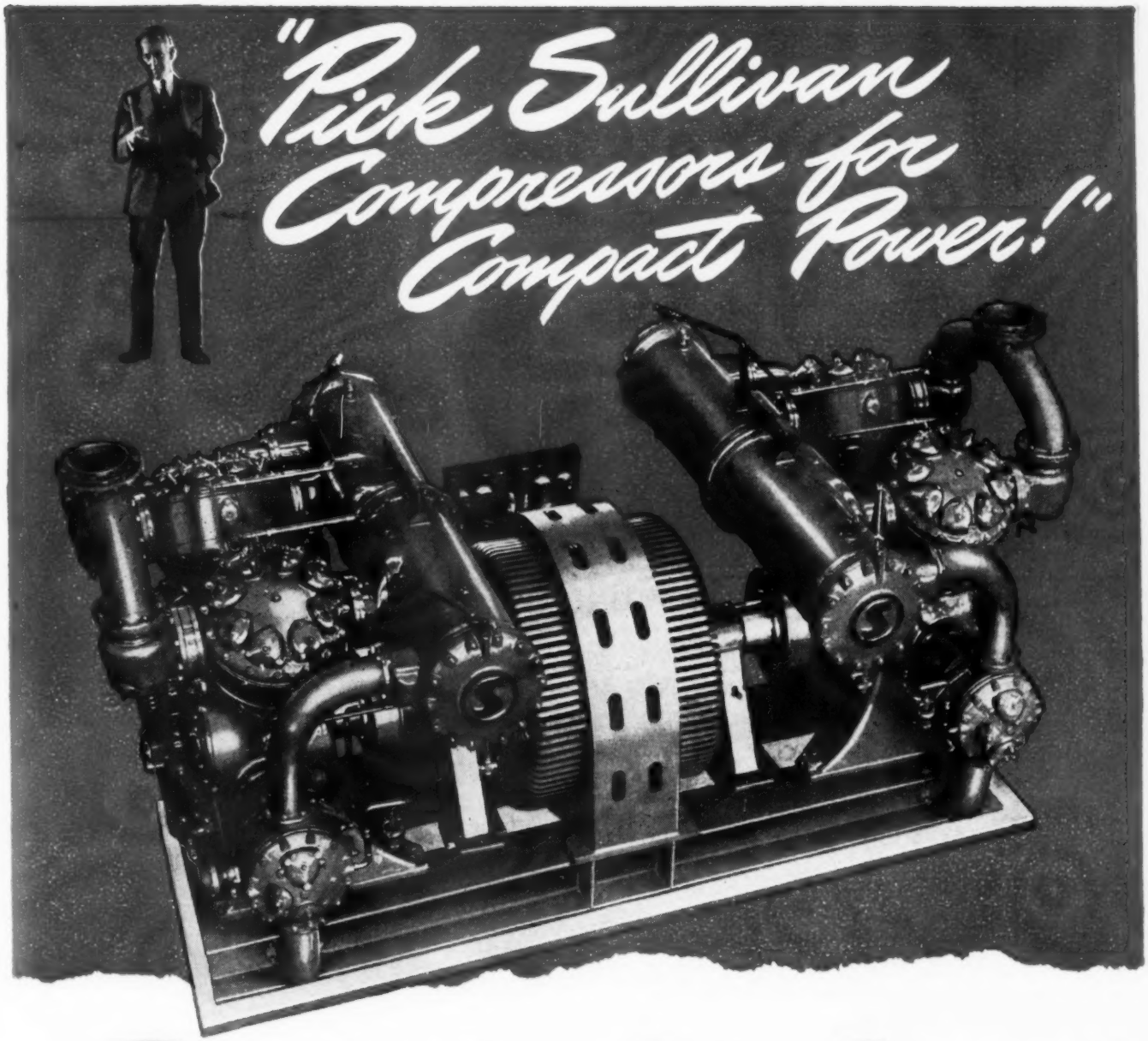
TROY ENGINE & MACHINE COMPANY

Established 1870

2517 Railroad Avenue • Troy, Pennsylvania

TROY-ENGBERG

STEAM ENGINES • GENERATING SETS • GENERATORS



Rugged...Heavy Duty...Economical

WN-114 COMPRESSOR

TAKES LESS FLOOR SPACE—HAS HIGHER CAPACITY

DELIVERING AIR UP TO 3,656 CFM

SULLIVAN

PORTABLE AND STATIONARY AIR COMPRESSORS

W&D. I 504

Consult a Joy Engineer

SULLIVAN DIVISION

JOY MANUFACTURING CO.

GENERAL OFFICES: HENRY W. OLIVER BUILDING, PITTSBURGH, PA.

SERVICE ALL THE WAY

OTIS MAINTENANCE FOR OTIS ELEVATORS

• Otis Maintenance extends all of the facilities and ability of the manufacturer directly to the buildings of Otis elevator owners.

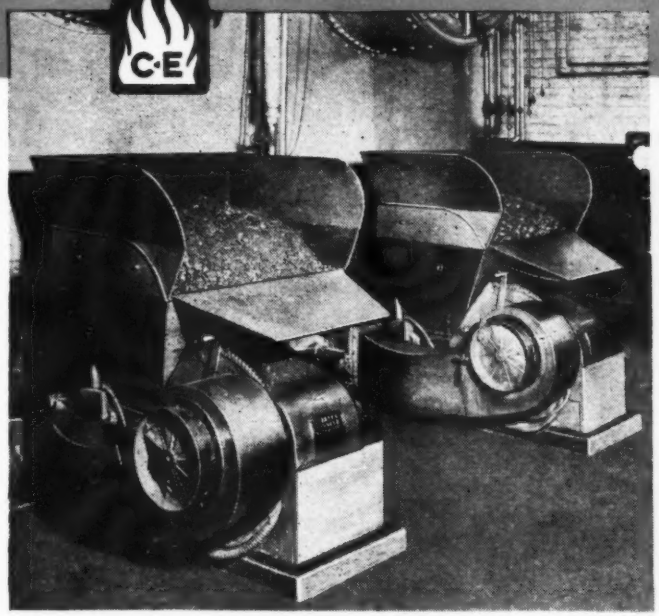
To bring this service to your door, Maintenance operations are conducted by 245 local Otis offices, each adapted to the area it serves. These branch offices in turn have the benefit of progressive improvements in service developed by the facilities that produced more than half of the world's elevator equipment. Thus Otis Maintenance goes all the way to meet the convenience of the Otis elevator owner.

Few things you buy can so exactly fit your needs.

Maintenance by Otis, for Otis elevators, is available at a flat monthly rate through your local Otis Elevator Company office.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

Why COMBUSTION ENGINEERING CO., Inc. Equips Underfeed and Traveling Grate Stokers with

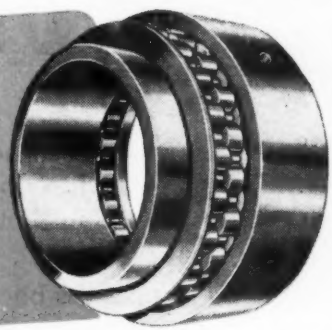


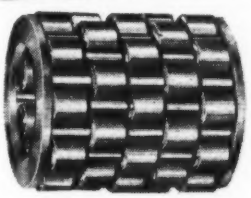
ORANGE ROLLER BEARINGS

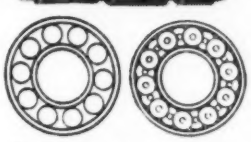
Combustion Engineering, another prominent user of Orange Roller Bushings *and* Orange Staggered Roller Bearings, writes, "In an emergency, when other sources of supply were unable to meet our requirements, we were able to obtain Orange Roller Bearings. We find that Orange Roller Bearing Company's delivery promises have been faithfully maintained, and the performance of the bearings is highly satisfactory."

Orange Bearings proved *so* satisfactory that today they are used in the driving mechanisms of C.E. Stokers of both underfeed and traveling grate types — in all sizes from 6 to 672 sq. ft. capacity.

ORANGE *STAGGERED* ROLLER BEARINGS





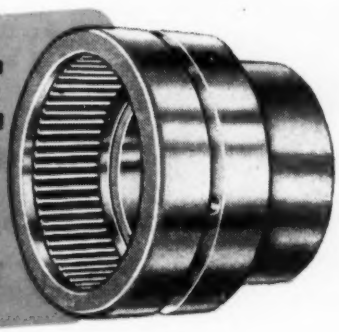


End views of a conventional roller bearing (left) and an Orange Staggered Roller Bearing. Note how staggered roller design provides a multiplicity of contact areas within the loaded zone.

Orange Staggered Roller Bearings combine great load carrying capacity in heavy operations with extremely smooth running in *precision* operations. They distribute the load over many short precision rolls — staggered to maintain roller alignment and to afford a multiplicity of contact areas within the loaded zone. Consequently, Orange Staggered Roller Bearings carry the same load as much larger conventional bearings — or conversely, have correspondingly greater capacity for a given size. They run smoothly and quietly, with exceptionally long life and freedom from trouble.

Made in a full range of standard *interchangeable* sizes — or special to your order. Write for Engineering Data Book.

ORANGE ROLLER BUSHINGS



Orange Roller Bushings are widely specified for their high load-carrying capacity, coupled with minimum space requirements.

Rigid standardization of dimensions permits much closer internal running clearances, maintaining true alignment of rollers with raceways. Exceptional standards of heat-treating, finishing and assembly are enforced. Ample overload capacity is designed into every bearing.

Orange Roller Bushings are made in a full range of types and sizes for easy incorporation in machine designs. Consult our engineering department for cooperation on bearing design problems. Send coupon for our Engineering Data Books. No obligation.

ORANGE ROLLER BEARING CO., INC.
567 Main Street, Orange, N. J.

— Mail Coupon for Engineering Data —

Orange Roller Bearing Co., Inc.
Orange, New Jersey

Please send me your Roller Bushing and Staggered Roller Bearing Data Books.

NAME ..... TITLE .....

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ADDRESS .....

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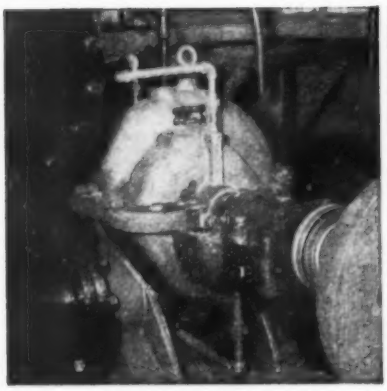
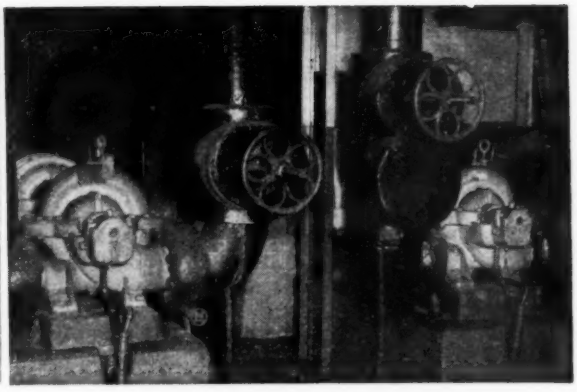


Two of the several Warren Pumps on duty at SCHRAFFT'S —manufacturers of nationally famous

SCHRAFFT'S CHOCOLATES

Left: Circulating Salt Water for Condensers. *Right:* Circulating Chilled Water for Air Conditioning System.



A "Sweet" Story

for those who need better PUMPS

You get more for your pumping dollars when you specify WARREN

You get the benefit of nearly half a century of highly specialized experience in building a great variety of pumps . . . for Power, Paper, Chemical, Textiles, Mining, Oil, etc., etc.

You get pumps that are smooth-running and free of vibration . . . because they are hydraulically and mechanically balanced.

You get pumps that are given a running test and all guarantees verified before shipment.

You get pumps whose reputation for *Maintained Efficiency* is a matter of on-the-job record in thousands of installations.

You get pumps backed by one of the largest makers devoted exclusively to pump building.

You get personal attention and interest from a nation-wide network of trained service representatives.

Why not put your next pumping problem up to us . . . and to expedite matters, please give us as complete data as possible.

Warren Steam Pump Company, Inc.
WARREN, MASS.

Atlanta Boston Chicago Cincinnati Cleveland Detroit Houston Hartford Los Angeles Minneapolis New Orleans New York Philadelphia Pittsburgh Richmond San Francisco Seattle St. Louis

P5

WARREN PUMPS

Now...

PALMETTO PACKINGS

are easy to get!

In response to the nationwide acceptance of the world-famous PALMETTO Packings, Greene, Tweed & Co. has established a network of *strategically* located Stocking Distributors throughout the United States. Now, *particular* engineers can reach out for the quality and service they want . . . and get it in a jiffy!

No matter what your packing problem . . . call in the PALMETTO Distributor. There's one near you with a complete stock for all applications . . . he has the *correct* PALMETTO Packing for serving your needs—and for saving your money.

Write for representative literature and nearest distributor.

GREENE, TWEED & CO.

MANUFACTURERS OF PALMETTO PACKINGS

Bronx Blvd. at 238th Street, New York 66, N. Y.
Plants at New York, N. Y. and North Wales, Pa.

One name... all Sizes, Types and Reduction Ratios

In fact, Phillie Gear was one of the true Pioneers in the design and manufacture of *Speed Reducers, for Industrial Purposes.*

For every conceivable type of Industrial Drive, there is a correct type of Philadelphia Speed Reducer—and by choosing Philadelphia Reducers, you not only secure *Quality Products,* but you place the responsibility for their construction and operation with *one manufacturer* (a point worthy of serious consideration).

PHILLIE GEAR

PHILADELPHIA SPEED REDUCERS ARE THE RESULTS OF 54 YEARS CONTINUOUS EXPERIENCE

Philadelphia GEAR WORKS INCORPORATED

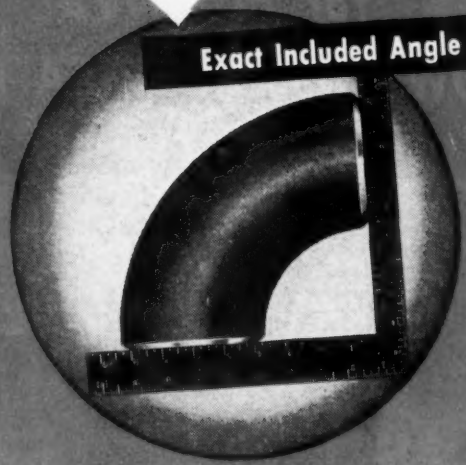
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO . . . IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

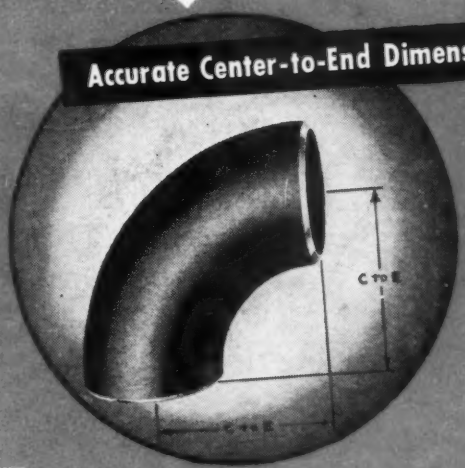
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

IMPORTANT FEATURES OF MIDWEST WELDING ELBOWS That Save Time and Money

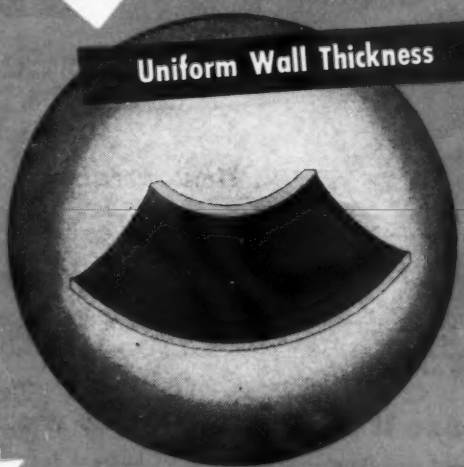
Exact Included Angle



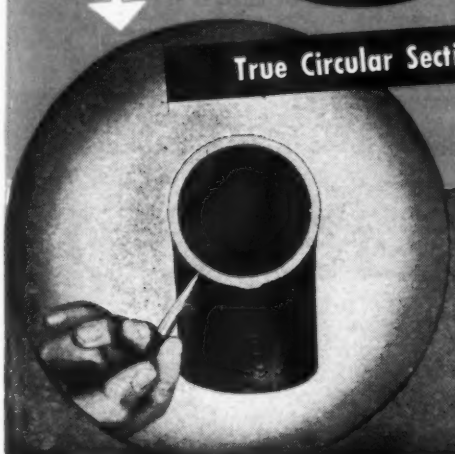
Accurate Center-to-End Dimensions



Uniform Wall Thickness



True Circular Section



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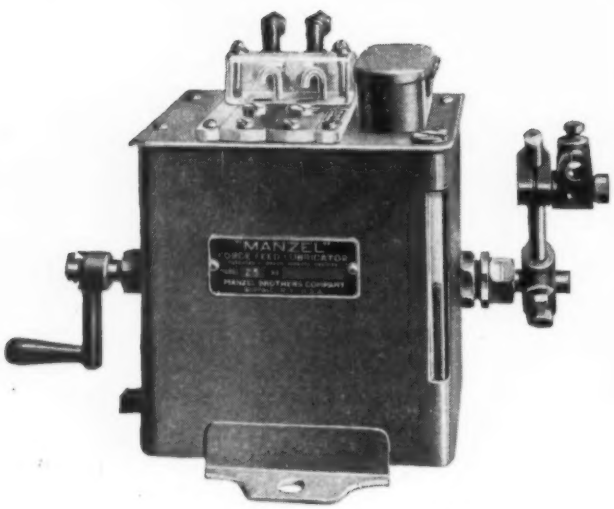

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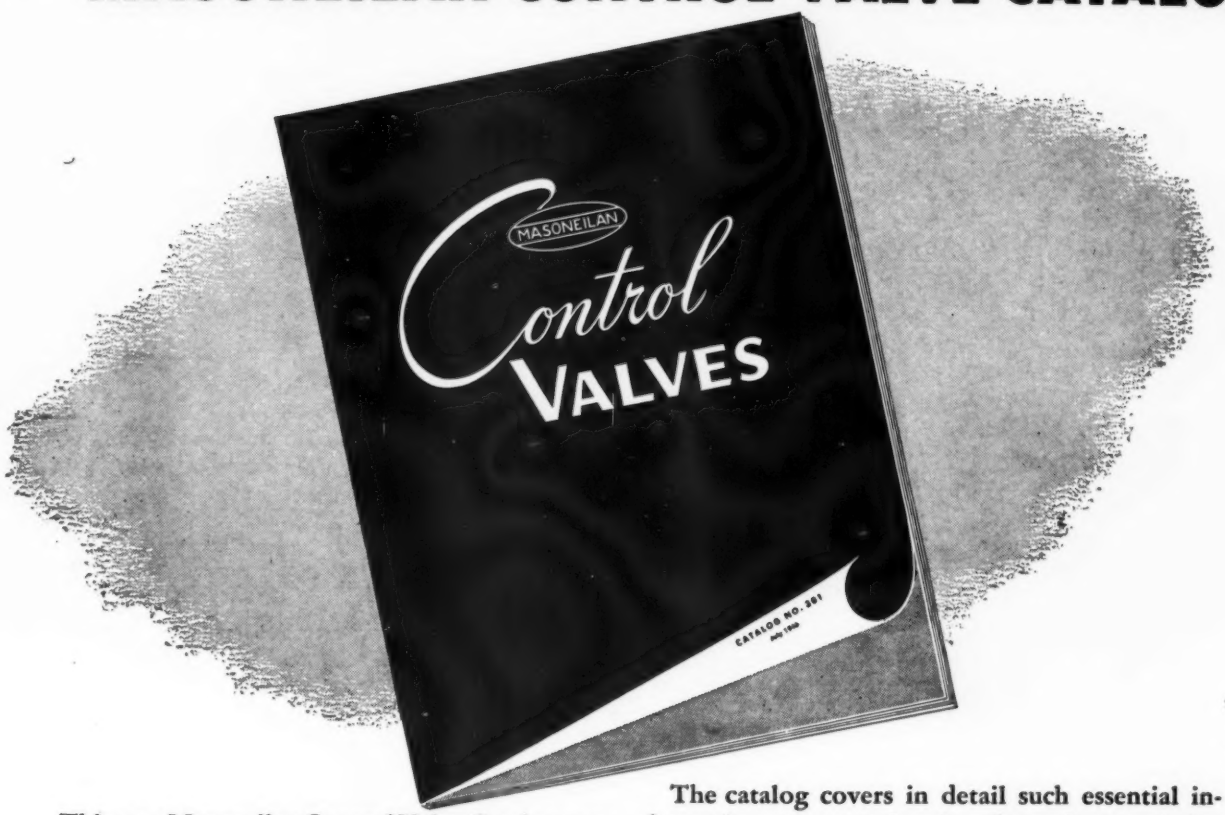

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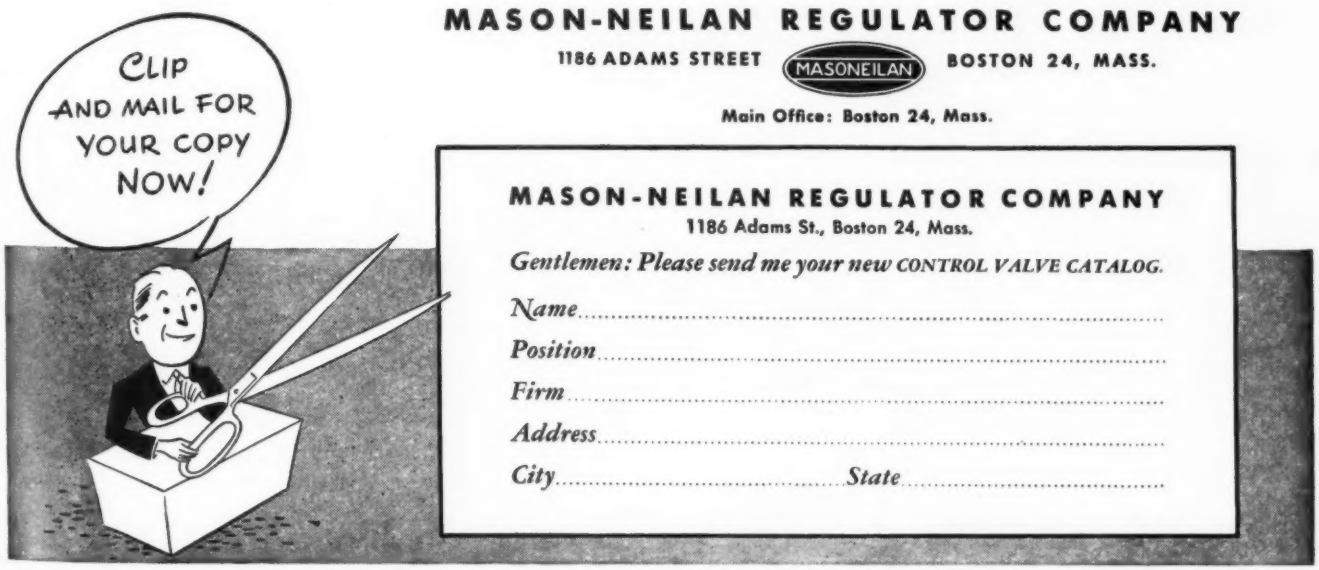

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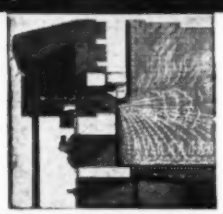

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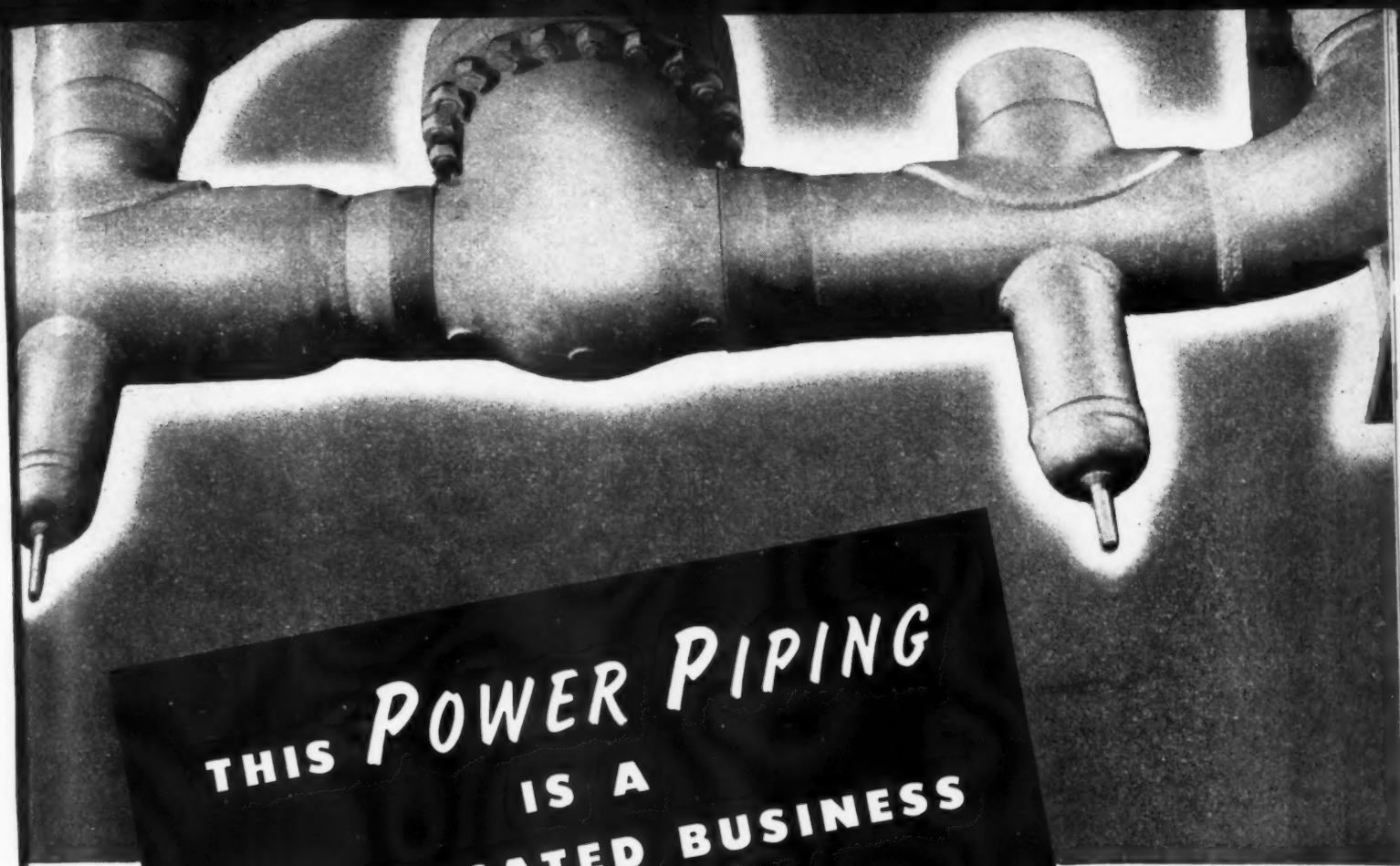

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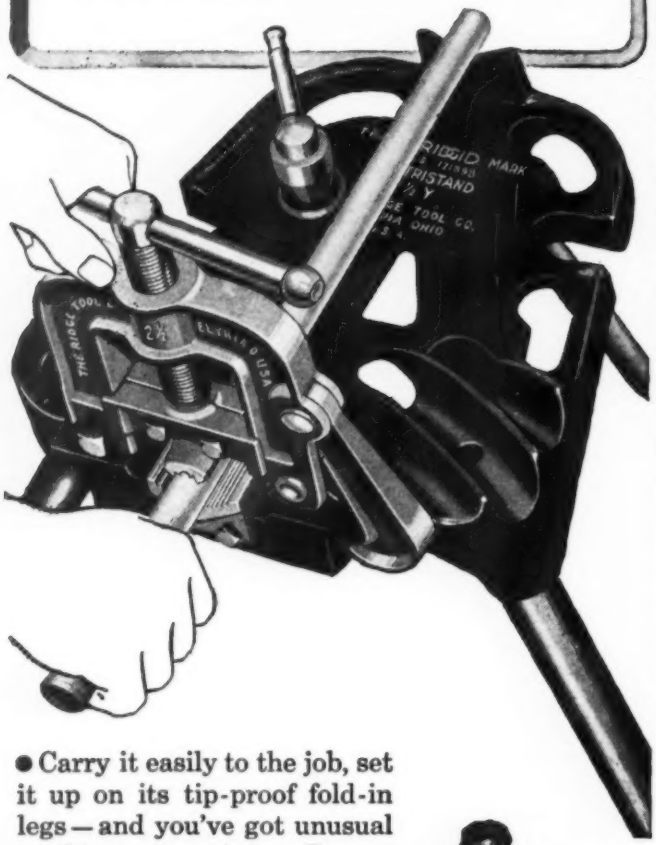

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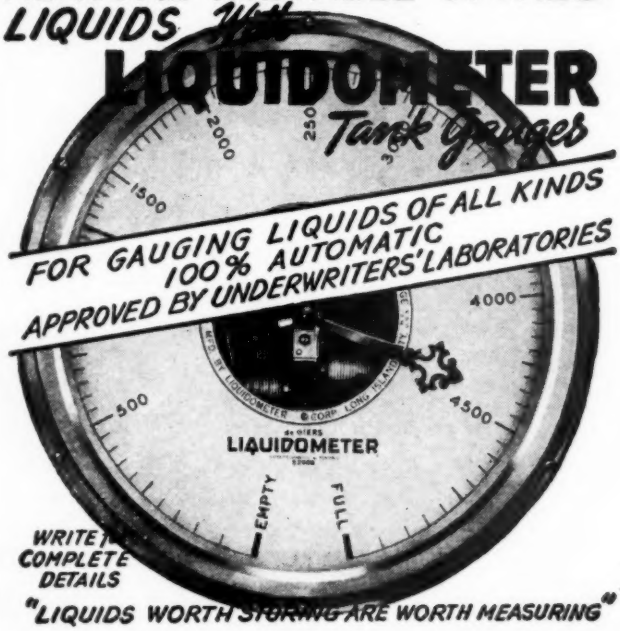

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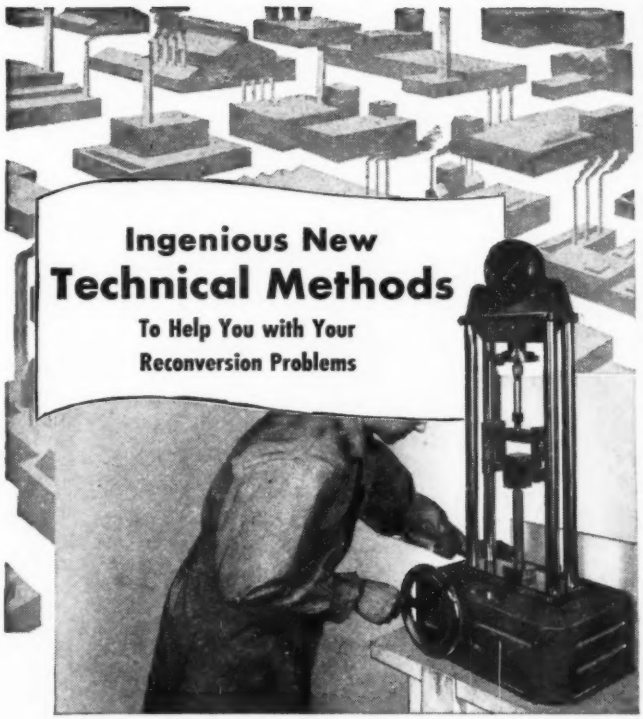

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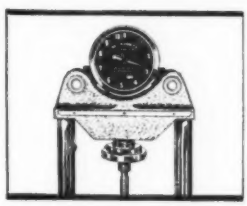

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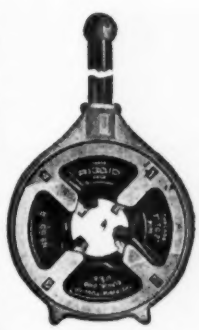

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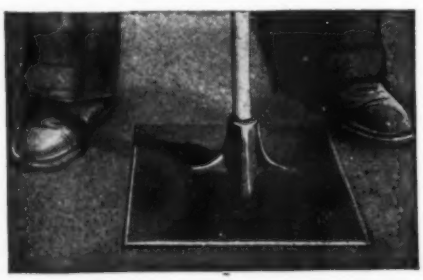

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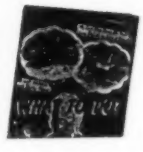

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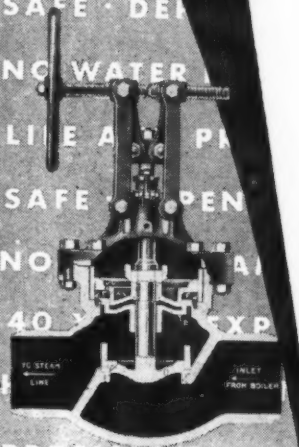

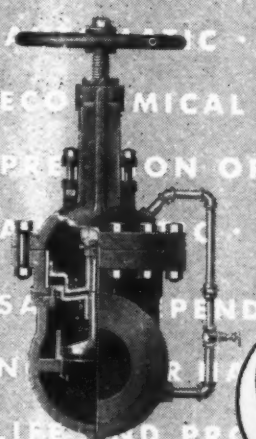

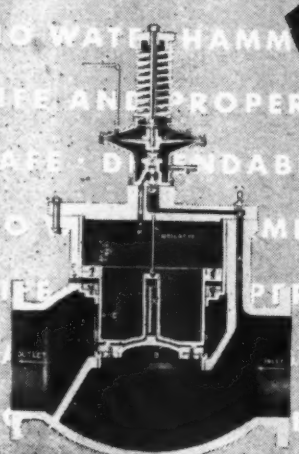

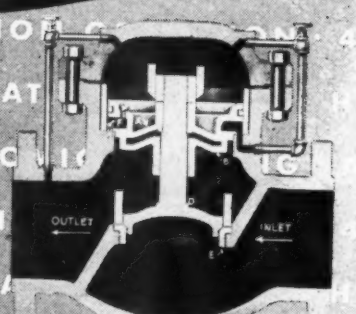

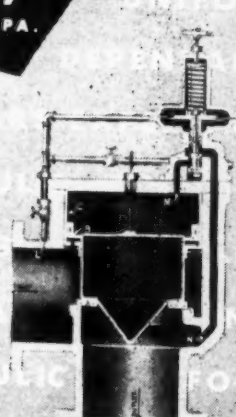

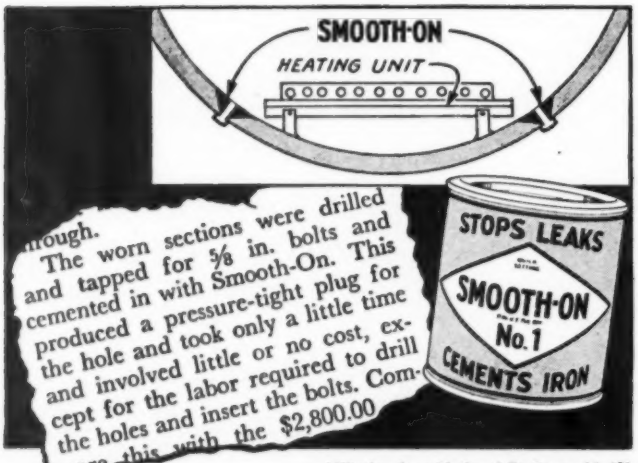

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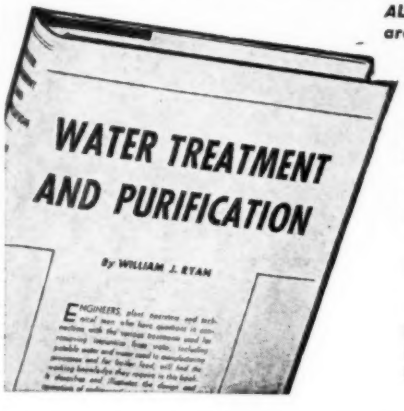

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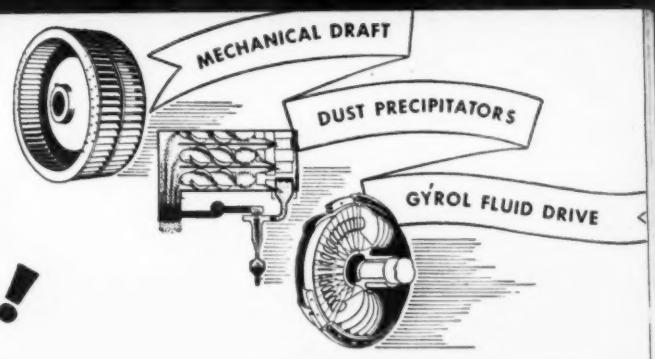

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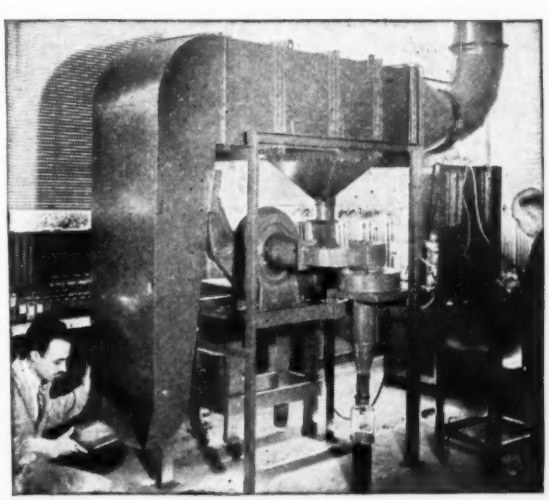

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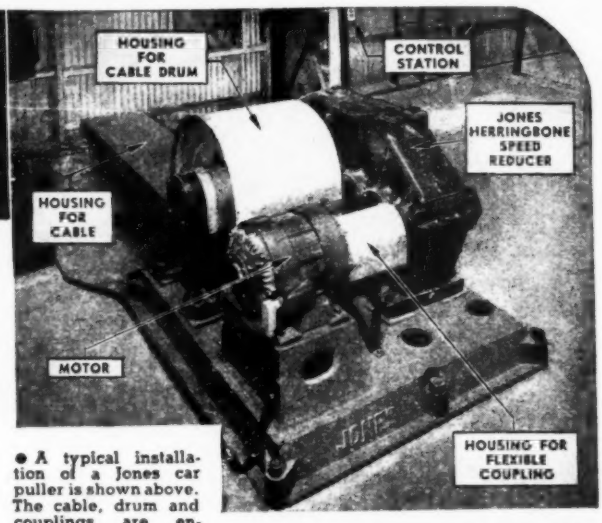
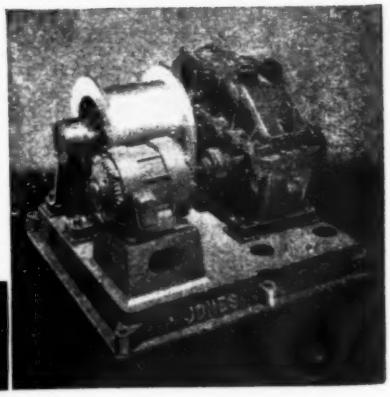


● A typical installation of a Jones car puller is shown above. The cable, drum and couplings are enclosed by sheet metal housings as an extra precaution in this installation to eliminate all hazard from moving parts.



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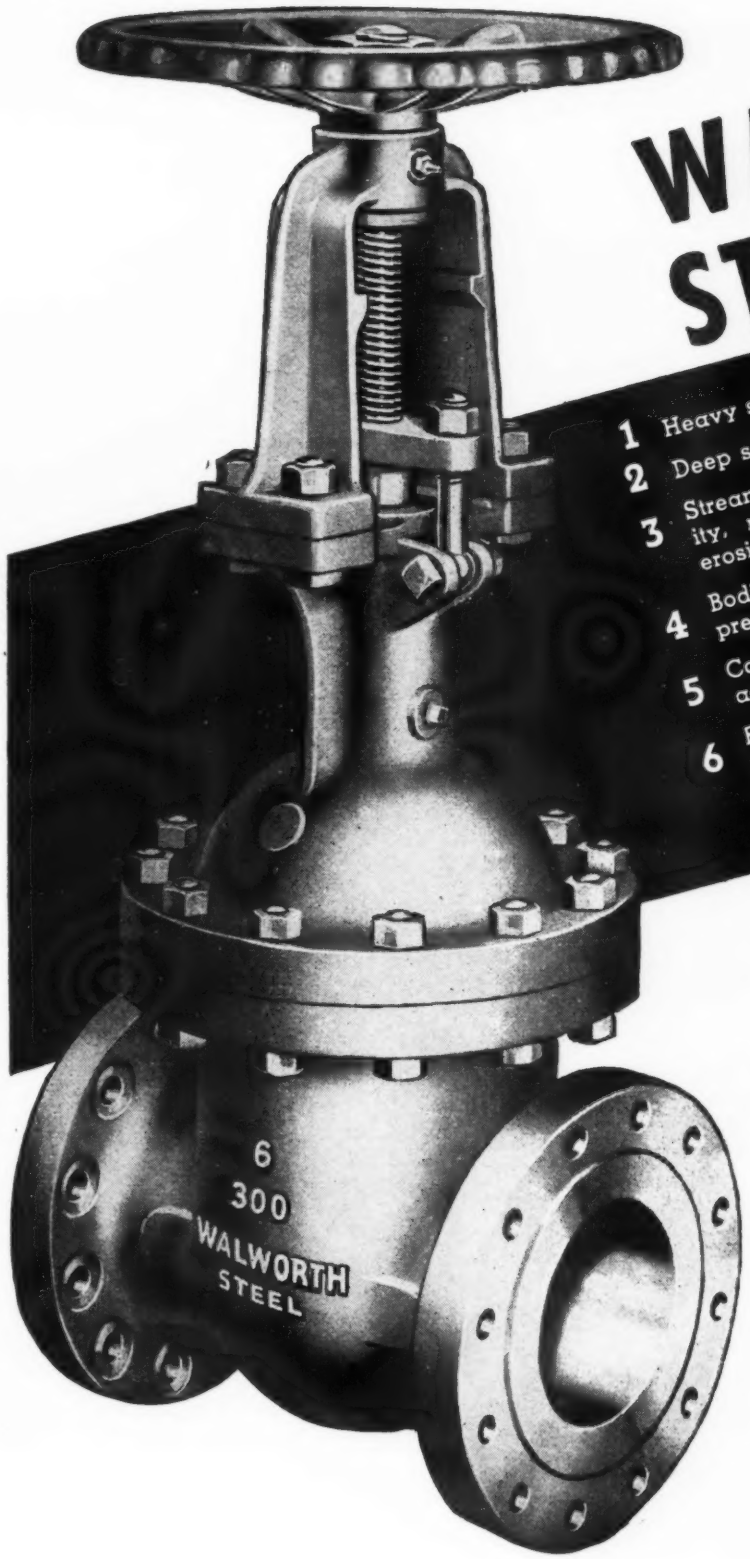

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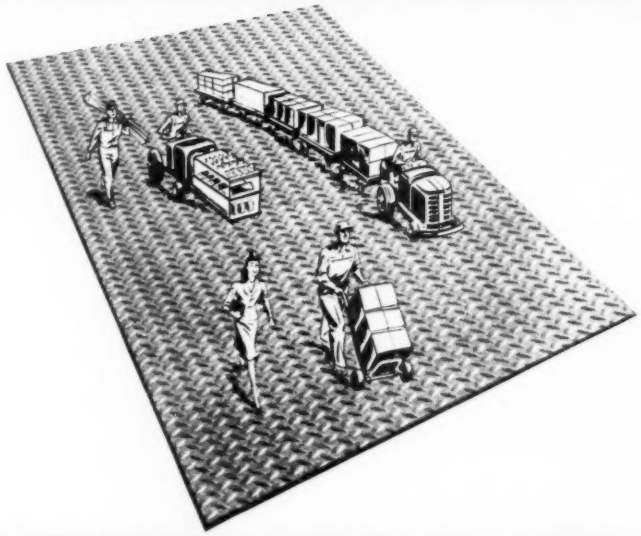

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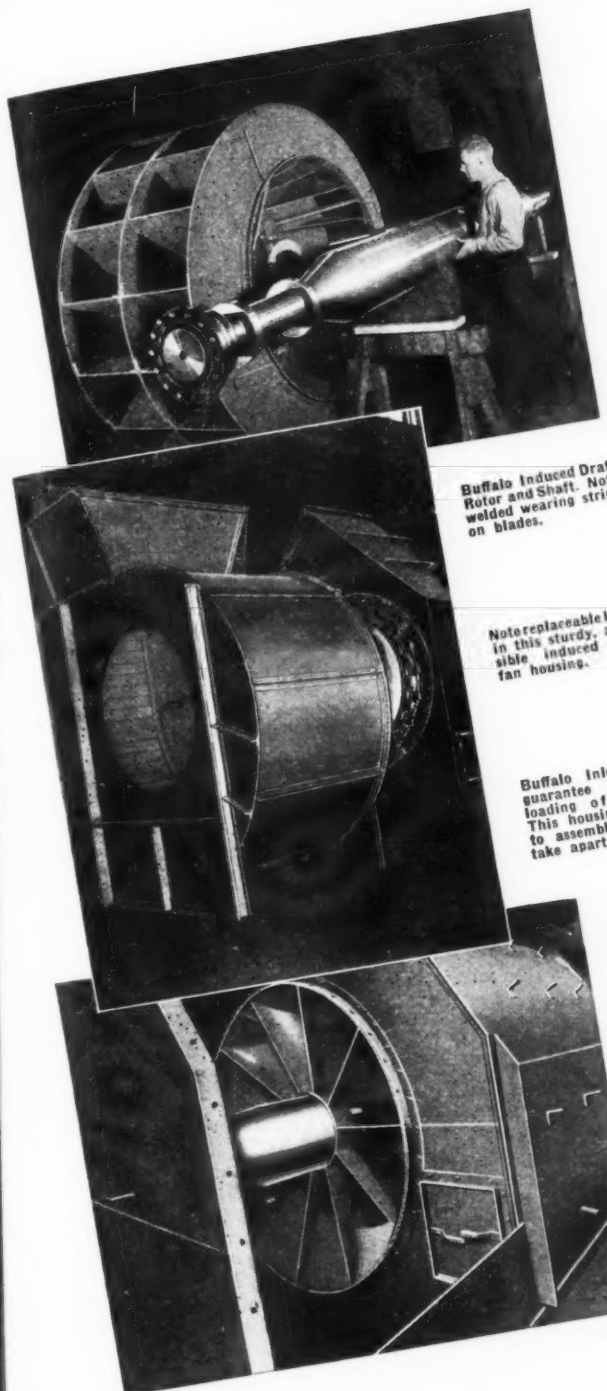

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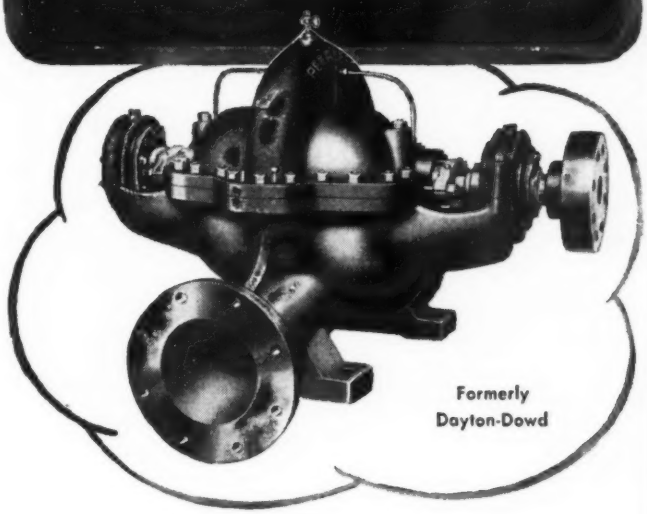

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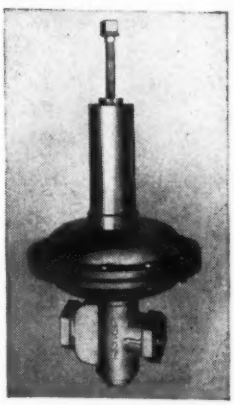

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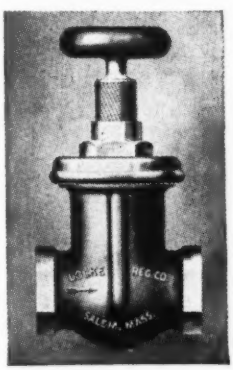

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PROPOSALS, 75 cents a line an insertion.

INFORMATION

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. P.

NEW ADVERTISEMENTS received by July 10th will appear in the August issue, subject to limitation of space available

Turf Development Board, Ltd.

Technical Development Supervisor

Applications are invited from Engineers, Physicists, and Chemists of distinction for a post involving the organization and supervision of a Technical Development Section which the Board proposes to institute.

Candidates for the post must possess technical qualifications of a high order, and experience in the supervision and control of technical staff and in the practical application of science to industry.

The new Section wil have among its aims:

(1) The improvement of existing mechanical devices for the drainage of bogs and the winning and utilization of turf (peat), and the introduction of better methods for carrying out these objects.

(2) The study of chemical and physical problems associated with the dehydration of turf (peat).

(3) Examination of the stratigraphy of bogs.

(4) Examination of the chemical and physical nature of turf (peat).

The salary which will attach to the post will be commensurate with the experience and qualifications of the successful candidate but will not be less than £1,000 per annum.

Applications giving full details of age, qualifications and experience should be addressed to the Secretary, Turf Development Board, Ltd., 21 Fitzwilliam Square, Dublin, Ireland, and must be received not later than June 15th, 1946.

WANTED
MECHANICAL ENGINEER
For Steam Power Plant Design

An unusual opportunity for a young engineer well grounded in steam power plant design to join a growing organization

WESTCOTT & MAPES, INC.
New Haven, Connecticut

WANTED

Position of assistant power plant superintendent open in large woodworking plant near Chicago. Requires good working knowledge of steam and electricity generation, power plant maintenance, water softening and experience in power plant supervision.

Give all pertinent information in first letter. All inquiries will be held confidential.

The Singer Manufacturing Co.
2115 Western Avenue
South Bend, Indiana

WANTED
STRUCTURAL ENGINEER
For Design of Structural Steel and Reinforced Concrete Structures

An unusual opportunity for a young man experienced in the design of structural steel and reinforced concrete to join a growing organization

WESTCOTT & MAPES, INC.
New Haven, Connecticut

POSITIONS VACANT

LARGE INDUSTRIAL Concern has opening for graduate engineer under 36 years of age who is experienced in Construction & Mechanical Engineering. Excellent opportunity for right man to advance. Must be willing to travel and supervise construction and machinery installation at various company properties. Give qualifications, experience and photo. All communications will be answered and held in confidence. P-132, Power, 330 W. 42nd St., New York 18, N. Y

WANTED: MECHANICAL Designers with experience in power plant design and capable of checking high pressure piping and other plant layouts. Give complete information in first letter. Engineering Department—The United Light and Railways Service Company, Davenport, Iowa.

WANTED: MECHANICAL Draftsmen with experience in power plant design. Give age, education and past experience. Engineering Department—The United Light and Railways Service Company, Davenport, Iowa.

PRODUCT DESIGNERS—Oil burning equipment. Five positions open for product designers with experience in designing domestic or industrial oil-burning equipment. These positions cover domestic oil burners, domestic oil-fired boilers, domestic water heaters, domestic winter air conditioners and industrial oil-fired equipment including steam generators and conversion burners. Write giving full details. Salary open. York-Shipley, Inc., York, Penna.

JUNIOR MECHANICAL Engineer for general efficiency and operation work in high pressure steam power plant in a medium-sized chemical plant. P-159, Power, 520 N. Michigan Ave., Chicago 11, Ill.

SALES ENGINEER: with centrifugal pump experience desired. Permanent position with long established pump manufacturer. Salary open. Replies confidential. Please outline qualifications. Dean Hill Pump Company, 4000 E. 16th St., Indianapolis 7, Indiana.

SELLING OPPORTUNITY OFFERED

SALES ENGINEERS for proven electronic corrosion protection equipment. Several territories open. High commission paid. Knowledge of power plant operation required. Write full particulars. Nokem Engineering Co., Box 1647, Louisville, Ky.

EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of 36 years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated, through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered ond present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

STEAM
POWER PLANT ENGINEER
WANTED

One of nation's largest engineering firms needs man under 35 to understudy project manager at home office in Pennsylvania. At least 10 years experience with a major engineering firm and best references required. Must be able to design and estimate steam power plants, contact and negotiate with customers. Starting salary up to $600.00 monthly for properly qualified engineer. Address

P-156, Power
330 West 42nd St., New York 18, N. Y.

WANTED
ELECTRICAL ENGINEER
For Power Plant Design
Must have Public Utility Experience

WESTCOTT & MAPES, INC.
New Haven, Connecticut

To Employers Who Advertise for Men:

The letters you receive in answer to your advertisements are submitted by each of the applicants with the hope of securing the position offered.

When there are many applicants it frequently happens that the only letters acknowledged are those of promising candidates. Others do not receive the slightest indication that their letters have even been received, much less given any consideration. These men often become discouraged, will not respond to future advertisements and sometimes even question if they are bona fide.

We can guarantee that *Every Advertisement Printed in the Searchlight Section Is Duly Authorized.* Now won't you help keep our readers interested in this advertising by acknowledging every application received, even if you only return the letters of unsuccessful applicants to them marked, say, "Position filled, thank you." If you don't care to reveal your identity mail them in plain envelopes.

We suggest this in a spirit of helpful co-operation between employers and the men replying to Positions Vacant advertisements.

Classified Advertising Division

McGRAW-HILL PUBLISHING COMPANY, INC.

"Put Yourself in His Place"

Additional Employment Advertising on opposite page

SEARCHLIGHT SECTION

POSITION WANTED

MECHANICAL ENGINEER: age 36, desires permanent connection as power or plant engineer. Experience power plant construction, operation, and maintenance (1400psi) engineering studies, reports and tests. PW-160, Power, 330 W. 42nd St., New York 18, N. Y.

Positions Available

Wanted, Sales Manager for regulating and tank temperature control valves. Must be top notch engineering sales executive. Capable of making policy decisions.

We have excellent engineering and one of the finest manufacturing plants in the industry, so that sales are limited only by the promotional job we can do.

We have just acquired this forty year old valve manufacturing business and are looking for someone to develop and expand its sales organization into a strong aggressive unit.

Location, Hamilton, Ohio. Reasonable salary and substantial bonus.

SW-153, Power
520 North Michigan Ave., Chicago 11, Ill.

WANTED
SALES ENGINEERING AGENTS

Manufacturer of Pneumatic Ash Conveyors for Industrial and Utility Plants considering local agency representation in Philadelphia, Pittsburgh, Boston, Buffalo, Chicago, Cleveland, Detroit.

Companies or individuals with agency record in power plant line Apply to:

RW-151, Power
330 West 42nd St., New York 18, N. Y.

NEW YORK REPRESENTATION

Engineering Sales Organization more than 15 years Successful Experience wishes to handle Account of Power Plant—Process or Heat Exchange Equipment on Commission Basis. Can offer Concentrated Metropolitan and Vicinity Coverage.

RA-131, Power
330 West 42nd St., New York 18, N. Y.

WANTED EQUIPMENT ACCOUNTS

Power and industrial plant mechanical lines by registered mechanical engineer with extended experiences in sales and operation. Products must be proven by past performances and afford substantial income in reward for balanced engineering and sales efforts. Complete erection and maintenance services may be arranged. Indianapolis headquarters.

RA-154, Power
520 North Michigan Ave., Chicago 11, Ill.

NEW PRODUCTS WANTED

Our client, an established manufacturer, wants new products or new ideas that might be developed into new products.

Experienced in steel casting, welding and machining in any combination—large sizes, great precision.

Selling industrial and manufacturing markets.

Please write Dept. 20 Communications in confidence. We are fully compensated by our client.

Charles H. Welling & Co., Inc.
INDUSTRIAL CONSULTANTS
52 Vanderbilt Avenue
New York 17, N. Y.
New Products - New Processes

TO SELL YOUR BUSINESS FOR CASH
MAY BE A WISE MOVE NOW

YOU may be relieved of much worry and unnecessary expense.
YOUR company (its personnel intact, as a rule) will gain the benefit of added capital, plus the expert management of an experienced, reputable operating organization.
THERE is profit in it for all. As principals (not brokers) with substantial finances and a background of long experience, we are interested in industrial plants.

• *ALL consultations and negotiations strictly confidential*

Box 1234—1474 Broadway, N. Y.

FOR SALE

(Additional For Sale Advertising on pages 291-319)

1—200 HP Fairbanks-Morse Semi-Diesel Engine 14"x17", 4 cyl. Type Y, Style V, 257 RPM, connected to a 148 KVA Generator, 3 ph. 60 cy. 2300 volt, with a 5 KW Exiter 125 volts
For $3500.00

1—125 KVA Fairbanks-Morse Generator, #94854-D, frame 451, Type D, 80% P.F. 100 KW, 3 ph. 60 cy. 2300 volt, 31.4 amps, 150 HP. Engine #511563, Type Y, Style V, 257 RPM, with 7½ KW Exciter, X-33878, frame 71, Type C.P. 60 amps, 1400 RPM, 125 volts.....For $1500.00

1—Electric Machinery Generator Set, Ser. 2129, Hercules 6 cyl. gas Mod. WXLC3, 3 ph. 60 cy. 125 volts, 35 KVA with Exciter, completely rebuilt $1500.00

1—5 KW Kohler, 110 volts, AC, 60 cy. Manual Plant, rebuilt
$450.00

PORTER ELECTRIC COMPANY, INC.

330 S. 6th St. Minneapolis 15, Minn.
GEneva 8655
ELECTRICAL EQUIPMENT COAST TO COAST

MOTOR GENERATOR SET

1—200 KW 250 volt Compound Wound 1200 RPM direct connected to 1 - 288 HP 3 phase 60 cycle, 440 volts, 1200 RPM synchronous motor Allis Chalmers .8 P.F. 3 bearing, mounted on a common factory built base complete with AC and DC switchboard with auto transformer for automatic start.

Wire Orders Immediately.

THE MOTOR POWER CO. OF NEW YORK, INC.

859 Madison Avenue, New York 21, N. Y.
RHinelander 4-6478

FOR SALE
SURPLUS EQUIPMENT

One 28" x 36" Hamilton Uniflow Engine direct connected to G. E. 900 KW, .8PF, 150 RPM, 2300 Volt, 3 Phase, 60 Cycle Generator. This is a complete unit now installed in our plant.

For complete description and prices wire, telephone or write

FARLEY & LOETSCHER MFG. CO.
Dubuque, Iowa

BOILER PLANT
For Sale by Owner

5—312 H.P. each, Class XI—No. 16 B & W
Stirling Type Boilers—180# gauge operating press.
Complete with Type E Stokers
Forced Draft Fan—Boiler Feed Pumps
Water Filters, Piping, etc.

for information write

LARAMORE AND DOUGLASS, INC.
327 S. LaSalle St., Chicago

WANTED

We Will Buy

WE WILL BUY
MOTORS — AC & DC
GENERATORS
MG SETS
TRANSFORMERS
Controls &
Switchboards
Air & Oil
Circuit Breakers

ELECTRIC
GENERATOR
& MOTOR CO.
4523 Hamilton Ave.
Cleveland 14, Ohio
Phone ENdicott 5656
Established 1900

Cash Ready
FOR YOUR
ELECTRICAL EQUIPMENT

Electric motors, AC and DC
Compensators
Generators
Motor Generator Sets
Air and Oil Circuit Breakers
Panels
Exhaust Fans
Control Equipment
Send us list with full details
WIRE OR PHONE
P. O. Box 534

POWER EQUIPMENT CO.
154 ANDREWS ST. ROCHESTER 4, N. Y.
Telephone Main 568 or 569

WANTED
DIESEL GENERATOR SET

1 Diesel Generator Set complete. 300-350 k.w. 60 cycle, 240 volt, 3 phase, slow speed, heavy duty preferred. Specify complete details. No dealers.

SECURITY MILLS, Inc.
Box B, Newton 58, Mass.

WANTED
CATALOGS

General Catalogs of Westinghouse Co. years 1923—1924 and 1933 to 1938 inclusive. Also General Electric Co., from 1922 to 1929 inclusive.

W-157, Power
330 West 42nd St., New York 18, N. Y.

Air Compressors Wanted

STATIONARY—100 CFM AND UP
PORTABLES—2 STAGE
Ingersoll and Worthington Only

L. W. BAUER
North Bergen, N. J.

WANTED
ROLLER CHAIN
ANY SIZE—ANY MAKE—
ANY QUANTITY
NEW OR USED

W-129, Power
330 West 42nd St., New York 18, N. Y.

MOTORS WANTED

High Torque (Elevator or Hoist).
Any condition.

UTILITY ELEVATOR SERVICE
34 Jumel Place New York 32, N. Y.

WANTED
TURBO-GENERATOR

2300 V. (Other voltages would be considered.)

500 to 700 K. W. 150# Pressure

Call or Wire

GLAZER STEEL CORPORATION
610 Chamberlain St. Knoxville, Tenn.
Phone 3-0738

WANTED
ELECTRIC GENERATOR

10 or 15 K.W. Steam driven Electric Generator 220 Volt-3 Phase-60 Cycle—125# Steam. Must be new or in A-1 condition.

CRYSTAL ICE WORKS, INC.
Bartow, Fla.

WANTED
Corliss Right Hand Steam Engine

24" x 42"—125# pressure at throttle 10# back pressure—speed 70 to 80 RPM, flywheel 14' to 16' diameter.

CZARNIKOW-RIONDA CO.
EXPORT DEPARTMENT
106 Wall Street, New York 5, N. Y.

WANTED
1000 k.w. Condensing Turbine,

3 phase, 60 cycle, 3600 r.p.m., direct connected exciter, complete with condenser pump and auxiliaries, interconnecting pipes, switchboard and instruments. Specify all details as to age, length of service, and submit drawings.

SECURITY MILLS, INC.
Box B
Newton 58, Mass.

WANTED TO BUY

Complete paper mill or paper making machinery for immediate delivery. What have you to offer for immediate inspection.

A. C. ASKEW
Box 3073 Whittier Station, Tulsa 8, Okla.
Phone 6-6120

---

500 or 600 K.V.A.
DIESEL DRIVEN GENERATOR

3 Phase, 60 Cycle.
Give details, age and Price.

W-158, Power
520 North Michigan Ave, Chicago 11, Ill.

WANTED
Two D.C. MOTORS

TYPE MPC, CLASS 6—150 H.P. 500, Form A, 500 R.P.M. 250 Volts, General Electric—150 H.P.

W-973, Power
330 West 42nd St., New York 18, N. Y.

"SEARCHLIGHT"
IS
Opportunity Advertising

—to help you get what you want.
—to help you sell what you no longer need.

Take Advantage Of It

For Every Business Want
"THINK SEARCHLIGHT FIRST"

WANTED

One or two G.E. 175 H.P. type D.M.C. class 200 (6-173 H.P.—500) form L. 500 RPM—230 Volt, direct current motors—

Reply W152 Power
330 West 42nd Street, New York 18, N. Y.

When you buy Electrical Equipment- look to—

the judgement of experienced Electrical Engineers who KNOW Electrical Equipment

Hemphill rebuilding and testing is done under engineering supervision

MOTOR GENERATOR SETS

1—300 K.W. G. E. 275 V. 3 unit syn. motor 4150 V. 720 RPM.
1—150 K.W. Westinghouse 125 V. Sq. Cg. 220 V. 3 phase 900 RPM.
1—125 K.W. Crocker-Wheeler 125 V. Sq. Cg. 2300 V. 3 phase, 1200 RPM.
2—100 K.W. G. E. 230 V. A. C. Sq. Cg. 440 V. 3 phase, 60 cy. 1200 RPM.
1— 80 K.W. Crocger-Wheeler 3 unit 125 V. Syn. Motor, 220 V.
6— 17 K.W. Allis Chalmers 3 unit 120 V. Sq. Cg. 220 V. 1800 RPM.

TURBO GENERATORS

1—600 KW. Terry dual bleeder condensing Turbine only
1—300 KW. 125/250 Volt General Electric non-condensing
1—300 KW. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—30 KW. 135 volt, Allis-Chalmers, non-cond.

ALTERNATORS

1—500 KW. 3600 RPM. 600 volt, General Electric D.C. exciter
1—200 KVA 3600 RPM. 240 volt, Allis-Chalmers D.C. exciter
1—180 KW. 514 RPM. 550 volt, Westinghouse
1—165 KW. 514 RVM. 2400 volt, Electric Mach.
1—62½ KW. 3600 RPM. 220 volt, Allis-Chalmers
1—40 KW. 1800 RPM. 550 volt, General Electric
1—35 KW. 1200 RPM. 240 volt, Columbia Electric D.C. exciter
1—31.3 KVA. 1200 RPM. 120/208 volt, American D.C. exciter
1—12.5 KVA. 1200 RPM. 240 volt, Westinghouse, D.C. exciter

TRANSFORMERS

1—1000 KVA. Auto Transf. 4150 V. 3 Ph. 4 wire to 2406 V. 2 Ph.
2—400 KVA. General Electric, 4156-250/480 volt, Scott taps
3—200 KVA. Pittsburgh 2200 volt 110/220
3—100 KVA. Westinghouse 11430/250 volt
3—100 KVA. General Electric 13200/250 volt
3— 75 KVA. General Electric 13500/750/440 volt
2— 50 KVA. Pittsburgh 7500/15000 V. 110/220 v.
2— 15 KVA. General Electric 2300-115/230 volt

MOTORS—VARIABLE SPEED

230 VOLTS

2—200 H.P. 425/212 RPM. General Electric MPC
2—100 H.P. 950/1170 RPM. General Electric RC-37
1—40 H.P. 700/1000 RPM. Sprague L.C.
1—30 H.P. 400/120 RPM. General Electric R' C-204
1—25 H.P. 650/2200 RPM. Westinghouse SK-110L.
1—25 H.P. 500/1500 RPM. General Electric RF-12
1—25 H.P. 400/1200 RPM. Westinghouse SK
2—25 H.P. 300/900 RPM. Electro Dynamic
1—15 H.P. 300/1200 RPM. General Electric RLC-2024
1—13/18 H.P. 350/1200 RPM. Electro Dynamic
3—11½ H.P. 500/1500 RPM. Westinghouse
1—7½/10 H.P. 500/1500 RPM. Reliance
1—6/7.5 H.P. 450/1800 RPM. Crocker Wheeler CMC
1—5 H.P. 500/1500 RPM. Reliance
1—5 H.P. 600/1200 RPM. General Electric LC
1—5 H.P. 450/1800 RPM. Crocker Wheeler CM
1—5 H.P. 400/1600 RPM. Diehl K6
1—5 H.P. 225/900 RPM. Electro Dynamic

MOTORS 3 PHASE 60 CYCLE

SLIPRING

1—300 H.P. 900 RPM. Lincoln 440 volt
1—350 H.P. 293 RPM. General Electric MT-424 440 volt
1—250 H.P. 600 RPM. General Electric IM 2200 volt
1—225 H.P. 1800 RPM. General Electric I-E 220 volt
1—200 H.P. 600 RPM Crocker Wheeler S.R. 440 volt
1—200 H.P. 600 RPM. Westinghouse CW 220 volt
1— 75 H.P. 900 RPM. General Electric ITC 220 volt
1— 60 H.P. 575 RPM. Allis-Chalmers 220 volt
1— 40 H.P. 1150 RPM. Cont Electric SA85 220 volt
1— 40 H.P. 1130 RPM. General Electric Mt 2200 volt

MOTORS 3 PHASE 60 CYCLE

SQUIRREL CAGE

1—400 H.P. 1200 RPM. Westinghouse 220 volt
2—200 H.P. 1200 G.E. 1K. 2200 .
2—100 H.P. 1800 RPM. General Electric IK 440 volt.
1— 90 H.P. 380 RPM. Crocker-Wheeler 550 volt
1— 75 H.P. 690 RPM. Westinghouse 550 volt.
1— 60 H.P. 900 RPM. Howell Mfs. Co. SC. 220 volt
2— 50 H.P. 900 RPM. Fairbanks-Morse H. 220 volt
2— 25 H.P. 1800/1200/900/600 U. S., 440 volt, 3 phase

GASOLINE DRIVEN D. C. GENERATOR SETS

1—300 K.W. 250 V. G. E. MPC. 1000 RPM.
2—250 K.W. 250 V. Crocker-Wheeler Gen. 1200 RPM.
1— 75 K.W. 250 V. Westinghouse 260 RPM.
1— 50 K.W. 115 V. Westinghouse 1200 RPM.
2—31.25 K.W. 125 V. Westinghouse 1400 RPM.
2—20 K.W. 50 V. G. E. 1800 RPM.

MOTORS D. C. 230 VOLTS

2—450 H.P. General Electric MPL 250 volt 400 RPM.
1—250 H.P. 750 RPM. Electro Dynamic 230 volt
1—125 H.P. 1725 RPM. General Electric RC—230 volt
1— 75 H.P. 575 RPM. General Electric C 230 volt
2— 50 H.P. 700 RPM. Crocker Wheeler CM 230 volt
2— 30 H.P. 1150 RPM. General Electric RC-31 230 volt
1— 30 H.P. 1100 RPM. General Electric RC-12 230 volt
1— 30 H.P. 750 RPM. General Electric RC-14 230 volt
1—30 H.P. 625 RPM. General Electric C 230 volt
1— 25 H.P. 600 RPM. Westinghouse SK 230 volt
1— 20 H.P. 800 RPM. General Electric RC-12 230 volt
1— 15 H.P. 350 RPM. Diehl G-312 230 volt

SYNCHRONOUS MOTORS

1—500 KVA. G. E. 900 RPM. ATI 4150 V. D. C. exciter.
2—100 HP. Elec. Mach. 1800 RPM. 2200 V. D. C. exciter.
1— 75 HP. G. E. 1200 RPM. ATI 220 V. 3 phase.
2— 50 HP. G. E. 1800 RPM. TS 220 V.
1— 50 HP. G. E. 1800 RPM. ATI 220 V. D. C. exciter.
1— 35 KVA. G. E. 1200 RPM. ATI 2200 V. D. C. exciter.
1— 20 HP. Westinghouse 1800 RPM. 220 V. .8 P.F.

FREQUENCY CHANGERS

1—7½ K.W. 15 KVA. 50% P.F. 1800 RPM. 215 V. 270 Cy. C.W. Westinghouse.
2—15 K.W. G. E. Type MM, 270 cy.

VERTICAL MOTORS

4—100 G. E. Vert. Hollow Shaft 1200 RPM. 220 S.C.
1—100 G. E. Vert. Solid Shaft 900 RPM. 220 S.R.
1— 75 G. E. Vert. Solid Shaft 1200 RPM. 220 S.R.
1— 60 Westinghouse Solid Shaft 900 RPM. 2200 S.R.

MISCELLANEOUS

2—2100 Gallon Pumps Dayton-Dowd 190 foot head.

JLHCo

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J.L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

FOR SALE—IMMEDIATE DELIVERY

POWER PLANT EQUIPMENT

TURBINE-GENERATOR UNITS
3 Phase, 60 Cycle

6250 KVA Allis non-condensing, 450 lbs. pressure, 725° TT, 185 lbs. exhaust, 4500 volts, 3600 RPM.

4375 KVA G.E. condensing, 2300 volts, 3600 RPM, 200 lbs. pressure equipped with condenser.

4000 KVA Allis condensing, 200 lbs. pressure, 600 volts, 3600 RPM equipped direct connected exciter and surface condenser.

3750 KVA G.E. condensing, 200 lbs. pressure, 500° TT, 2,300 volts, 3600 RPM complete with surface condenser and switchboard.

2500 KVA G.E. condensing, 150 to 200 lbs. pressure, 2300 or 550 volts, 1800 RPM complete surface condenser, exciter and panel.

1875 KVA Westinghouse condensing, 175 to 200 lbs. pressure, 500° TT, 480 volts, 3600 RPM, complete with turbine driven exciter set, switchboard, Westinghouse jet condenser and condensing auxiliaries.

1563 KVA Allis non-condensing, 150 to 200 lbs., 15 to 25 lbs. gauge back pressure, 480 volts, 3600 RPM equipped with direct connected exciter and panel.

1250 KVA Westinghouse non-condensing, 200 to 250 lbs. pressure, 500° TT, 15 lbs. gauge back pressure, 480 volts, 3600 RPM, complete with exciter, switchboard panel.

1250 KVA Westinghouse condensing, 2400 volts, 3600 RPM, 200 lbs. pressure, equipped with direct connected shaft exciter, condenser, switchboard and instruments.

375 KVA Allis non-condensing, 150 to 175 lbs., 10 lbs. gauge back pressure, 240 or 480 volts, 3600 RPM complete with direct connected exciter and switchboard.

375 KVA G.E. condensing, 150 to 200 lbs. pressure, 100° SH, 2300 volts, 3600 RPM, complete with surface condenser and auxiliaries.

125 KVA Westinghouse non-condensing, 175 to 200 lbs. pressure, 0-10 lbs. gauge back, 240 volts with direct connected exciter and switchboard.

125 KVA G.E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete with switchboard.

100 KVA Westinghouse non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM complete.

ENGINE-GENERATOR UNITS
3 Phase, 60 Cycle
Alternating Current

900 KVA Allis-Chalmers, 480 volts, 150 RPM generator direct connected to 24" x 36" Filer Stowell semi-Unaflow engine.

575 KVA General Electric, 460 volt, 150 RPM generator direct connected to 24" x 36" Nordberg Unaflow engine, 150 to 175 lbs. pressure, 10 to 40# back pressure.

500 KVA Westinghouse, 460 volts, 164 RPM generator direct connected to 26" x 28" Skinner Unaflow non-condensing engine, 140 to 160 lbs. pressure, 0 to 10-lbs. gauge back pressure, Complete Installation.

500 KVA G. E. 2300 volt generator direct connected to Chuse Unaflow non-condensing engine.

312 KVA Elliott, 4000/2300/550 or 240 volts, 180 RPM generator, direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lbs. pressure, 6 lbs. back pressure.

300 KVA G. E. 2300/480/240 volts, 200 RPM generator direct connected to Skinner Unaflow non-condensing engine—Complete.

200 KVA Crocker-Wheeler, 240 volts, 400 RPM generator direct connected to Ames vertical Unaflow engine, 110 to 125 lbs. pressure, 5 lbs. gauge back pressure.

150 KVA G.E. 240 volts, 225 RPM generator direct connected to Ames Unaflow engine.

ENGINE-GENERATOR UNITS
Direct Current

300 KW Allis-Chalmers, 250 volts, 150 RPM generator direct connected to 24" x 28" Chuse Unaflow non-condensing engine, 130 to 150 lbs.

150 KW General Electric, 3-wire, 115/230 volt, 225 RPM generator direct connected to Skinner Universal Unaflow non-condensing engine.

125 KW, 125 volt, 250 RPM generator direct connected to 18" x 16" Elliott engine, 100 lbs. pressure, 10 lbs. back pressure, complete with switchboard.

75 KW Westinghouse, 125 volt, 1800 RPM non-condensing turbine generator unit.

75 KW Allis-Chalmers Terry, 125 volt-2400 RPM non-condensing turbine-generator unit.

15 KW (2) Crocker-Wheeler, 125 volts, 410 RPM generators each direct connected to an American Blower vertical engine.

SPECIAL OFFERINGS

125 KVA (8), 3 phase, 60 cycle, 480 volts, 514 RPM Electric Machinery horizontal synchronous generators. NEW.

500 KVA Westinghouse, 3 phase, 60 cycle, 600 volts, 514 RPM belted generator.

750 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts alternating current generator, direct connected to 910 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

1200 KVA General Electric, 3 phase, 60 cycle, 2400 volts alternating current generator direct connected to 1700 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

750 HP Babcock & Wilcox Sterling water tube boiler ASME National code, 225 lbs. pressure, complete with stoker.

500 KVA (3) single phase, 60 cycle 6600/6000 volt primary, 2300 volts secondary Pittsburgh transformers.

5300 sq. ft. Worthington surface condenser.

6000 sq. ft. C. H. Wheeler surface condenser.

1—10 Ton Brown Hand operated crane with 31'0" span, approximately 150 ft. 15" I beam with 6" wide flange.

1—ALLIS-CHALMERS SYNCHRONOUS MOTOR GENERATOR SET CONSISTING OF: 1500 KW 550/600 volts, 300 RPM compound wound interpole direct current generator direct connected to a 2190 HP, 3 phase, 60 cycle, 4000 volt, 300 RPM A.C. motor.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

TWO BULLSEYES!

WE OWN WHAT WE ADVERTISE

BELYEA

SUCCESSFUL OPERATION GUARANTEED

WE buy it before you buy it—SO IT HAS TO BE GOOD—and you GET IT QUICKER!

RE-NU-BILT BELYEA MOTORS

Because it's RE-NU-BILT by specialist in Electrical Power Equipment!

"SUCCESSFUL OPERATION GUARANTEED"

MOTOR GENERATOR SETS
3 Phase—60 Cycle

1—1500 KW G.E. 275 V. D.C. to 2400 H.P. 4400/2200 V. Syn. with exciter.
1—400—3 unit with 2—200 KW—GE DC gens. and 700 HP. 2300 v.
1—300 KW—Cr. Wh. 3 unit with 150 KW. 125 v. D.C. gens. and 450 HP—4150 v. Syn.
1—150 KW. GE—250 V. DC to 250 HP—440 V. Ind. Motor.
1—150 KW—Whse. 600 V. D.C. to 200 HP—2200 V.
1—150 KW Whse. 3 unit (2) 75 KW 125 V. Gen. D.C. to 200 HP—2300 V. Ind.
1—150 KW. GE 600 V. d.c. to 225 H.P. 440 V. Syn.
1—85 KW. GE—250 V. DC to 150 HP—440 V. Ind. Motor.
1—75 KW GE 125 V. D.C. to 120 HP—2300/4000 V. Ind.
1—50 KW GE 125 V. D.C. to 75 HP—2300/4000 V. Ind.
2—48 KW. 3 unit with 2—24 KW GE 60 volt D.C. gens. and 60 HP—440 v. Sq. Cg.
1—45 KW. Whse. 250 V. D.C. to 75 HP. 440 V.

SPECIAL
1—500 KW—GE 250 V D C to 700 HP—2300/4150 Syn. Motor—3 phase—25 cycle with Controls.

TRANSFORMERS—60 Cycle

Qu.	Kva.	Make	Ph.	Type	Voltages
1	1050	G.E.	3	WCTH	11000x445/222½
4	525	G.E.	1	HJ	2300x445
2	333	Pitts.	1	OISC	2400x220
1	300	Pitts.	3	OISC	4150x208/120
3	200	G.E.	1	HJ	2300x408/204
1	200	G.E.	2-3	Auto	2500x2500
3	100	G.E.	1	HJDD	13200x445/226
3	100	Whse.	1	OISC	13200x250

A. C. GENERATORS
3 Phase—60 Cycle

Qua.	Kva.	Make	Type	RPM.	Volts
1	37.5	G.E.	ATI	1200	220/127
1	45	Whse.		514	2300
1	125	G.E.	ATI	900	2300
1	337	Whse.		360	480

A. C. MOTORS
3 Phase—60 Cycle
SLIP RING

Qu.	H.P.	Make	Volts	R.P.M.	Desc.
1	2500	G.E.	6600	253	MT
1	800	Al. Ch.	440	885	ANY
1	600	Cr. Wh.	2200	507	131 AQ
1	600	Whse.	440	400	CW
1	600	G.E.	2200	600	MT
1	350	G.E.	4000/2300	253	MT-442Y
1	250	G.E.	4000	257	MT-424Y
1	225	G.E.	550	720	IM-17
1	200	Whse.	2200	600	CW
1	150	Whse.	2200	580	CW
1	75	G.E.	2200	900	MT-356
1	60	G.E.	2200	1755	MT-337

SQUIRREL CAGE

1	725	G.E.	13800/2300	600	KT
1	400	G.E.	2200	1175	IE-15B
1	400	Whse.	2200	585	CS-1104
1	300	G.E.	2200	600	IK
1	300	G.E.	440	900	IK
1	250	G.E.	440	600	IK
1	200	G.E.	550	580	IK
1	200	G.E.	2300	1175	IK
1	200	G.E.	440	580	IK
1	200	Al. Ch.	2300	1175	
2	175/112	G.E.	440	900/720	IK
2	150	G.E.	440	1200	K-6325SB. Brg
2	150	G.E.	440	600	IK
1	100	G.E.	440	900	IK
1	100	G.E.	2300	450	IK-Vert.

SYNCHRONOUS

2	2100	G.E.	2200/4400	514	ATI
1	700	Whse.	4600/2300	1200	
1	125	G.E.	2300	900	ATI

SYNCHRONOUS CONDENSER

1	5000	Whse.	2300/4000	900

ROTARY CONVERTER
3 PHASE—60 CYCLE

Qu.	Kw.	Make	Speed	D.C.V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	Whse.	900	600	11000
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300

3 PHASE—25 CYCLE—BOOSTER TYPE

2	1500	G.E.	500	225/275	13200/6600

All units can be furnished with A. C. & D. C. control.

SPECIAL
1—2000 amp., 3 pole, 15000 V Conduit type F-120-15 D, 230 V Sol. operated OCB —1000 000 uninterrupting capacity.

D. C. MOTORS

Qu.	H.P.	Make	Type	Volts	Speed
4	800/1000	Whse.		450	600/750
1	800	G.E.	MPC	550	600
2	700	G.E.	MCF	600	150/525
1	650	G.E.	MPC	250	115/145
1	325	Whse.		230	1050/1250
2	350	G.E.	MPC	230	450
1	300	G.E.	MPC	230	275/550
1	300	G.E.	DMC	230	400/600
2	300	Cr. Wh.	CCM-151H	230	630/700
1	250	G.E.	MPC	230	400/500
1	250	Al. Ch.		230	525
1	135/175	G.E.	MCF	230	450/1050
1	150	G.E.	MPC	230	250/450
2	130	Cr. Wh.	CMC-65H	550	1200
2	125	G.E.	CO-1832	230	625
1	75	Cr. Wh.	100HL	230	350/900
1	75	Whse.	SK-180L	115	650
1	75	G.E.	C	230	650/900

TURBO GENERATOR SETS

1—500 KW—Whse. 625 KVA. 440 v. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lbs. condensing turbine with jet condenser and accessories.
1—75 KW Ridgeway 250 V. D.C. with Terry 180 lb. with 12 lb. back pressure, 2000 RPM.

38TH YEAR OF SERVICE

WE OWN WHAT WE ADVERTISE
IT HAS TO BE GOOD!

BELYEA COMPANY, INC.

We Buy for Stock — for CASH
What Surplus Do You Have?
PHONE—JOURNAL SQUARE — 2-3334
Also
N. Y. CITY LINE — RECTOR 2-7150

Main Office and Shop
43 HOWELL STREET
JERSEY CITY 6, N. J.

Dependable Rebuilt Electrical Equipment

1 YEAR GUARANTEE

3 Ph. Squirrel Cage Motors

Qu.	H.P.	Make	Type	Speed
1	147	West.	25 cyc.	715
1	70	G.E.	Synch.	1200
3	60	G.E. & West.		690
1	50	G.E.	KT-326	1750
1	50	West.	CCL	1150
1	50	Cr. Wh.	122Q	865
1	50	West.	CS	580
1	50	G.E.	I-14	495
1	46	W.E.		150/900
1	40	Triumph	TR	690
1	40	W.E.		150/900
1	35	Wagner		850
1	30	U.S.	Vert.	3450
1	30	Cr. Wh.		870
1	30	Watson		850
1	30	West.	CCL	690
1	25	Wagner	Fy. Welch.	1200
1	25	Wagner	Vert.	1160
2	25	West.	CS	1160
1	25	G.E.	IK	870
1	20	G.E.	KT-312	1700
1	20	G.E.	Vert.	1750
1	20	R & M	K-207	1160
1	20	West.	CS	1150
1	20	G.E.	Vert.	1175
1	20	Al. Ch.		870
1	20	Diehl		860
1	15	Wagner	Fy. Welch.	1800
1	15	El. Spec.	Synch.	1800
1	15	G.E.	KT-312	1150
1	15	Howell		1150
1	15	Al. Ch.		1150
1	15	Lincoln		1150
4	15	West.	MS	1150
1	15	G.E.	Vert.	870
1	15	G.E.	KT-512	870
1	15	Wagner	15VPR	860
1	15	Wagner	Fy. Welch.	720
1	15	West.	CS-504	415

2 Ph. Squirrel Cage Motors

Qu.	H.P.	Make	Type	Speed
1	70	G.E.	Synch.	1200
1	50	Lincoln	C-15	870
1	50	G.E.	IQ	870
1	40	Al. Ch.		870
1	35	Al. Ch.		870
1	30	West.	CCL	1150
1	30	Wagner	BP	1140
1	25	Burke		870
3	25	G.E.	IQL	1150
1	25	West.	CCL	1150

LEEDS & NORTHRUP
MICROMAX

INDICATING
THERMOCOUPLE PYROMETERS

Model S Recorders

Model C Controllers

Model B Recorders

Some New—
All Others Equal to New

2 Ph. Squirrel Cage Motors

Qu.	H.P.	Make	Type	Speed
1	15	F-M		1750
1	15	G.E.	KQ-502	1150
1	15	West.	CS	1155
1	15	Al. Ch.		1130
1	15	West.	CS-572	860
1	15	G.E.	IQ	690

A.C. Slip Ring Motors

Qu.	H.P.	Make	Type	Speed
1	200	Cr. Wh.		600
1	112	G.E.	ITC	720
1	75	Al. Ch.	Hoist	575
1	64	G.E.	MTO-552	585
1	60	West.	CW-956A	290
1	50	G.E.	MT	600
1	52	G.E.	ITC	860
1	50	Al. Ch.		865
1	50	G.E.	MT-342	860
1	40	West.	HF	850
1	40	G.E.	MT-352	570
1	35	Al. Ch.		870
1	30	G.E.	ITC	1200
1	30	G.E.	M-526	1150
1	30	G.E.	MQ-332	870
1	30	West.	CI-574A	870
4	30	West.	CI-582C	870
2	30	G.E.	MT-542	690
2	25	Al. Ch.		870
1	25	Howell	SRS-420	870
1	25	G.E.	IM	565
1	20	West.		870
1	15	G.E.	MT-502	1130
1	15	West.	CW	870
1	15	G.E.	MT-512	845
1	15	Al. Ch.		680
1	15	G.E.	MQ-332	670

A.C. Generators

Qu.	K.W.	Make	Voltage	Speed
1	106	El-Mchy.	208/120	1200
1	150	G.E.	240/480	600
1	100	West.	240/480	600
1	50	F-M	240/480	1200
1	50	El. My.	208/120	900
1	30	Burke	220/440	900
2	30	Century	208/120	1200

230 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	350	West.	SK	340/425
1	60	G.E.	C-Inter.	480/1100
1	50	G.E.	RC-19	400/1200
1	45	Diehl	K-10	850
1	40	G.E.	DLC	1050
2	35	West.	SK-120	1150
1	35	G.E.	RLC-204	440/800
2	35	West.	SK-160	400/600
1	30	G.E.	RC-32	1100
1	30	West.	SA	500/1500
3	25	G.E.	RC-31	1150
1	25	West.	SK	1100
1	25	Reliance	92T	1150
1	25	Al. Ch.		850
1	25	Rel.	H3	400/1200
1	25	G.E.	RF	400/1200
3	20	G.E.	RF	500/1500
1	20	G.E.	RF	400/1200
1	20	G.E.	CD-83	1200
1	20	R. & M.		1160
1	20	G.E.	RC-11	1150
3	20	West.	SK-110L	750
1	20	West.	Hoist	700
1	15	Rochester		3450
1	15	West.	SK-83	1150
2	15	G.E.	RC	1150
1	15	G.E.	CD-Vert.	900
1	15	G.E.	CD-85	850
2	15	G.E.	RC-30	850
1	15	Sprague	D	700
1	15	West.	SK	675/1350
1	15	West.	SK-100L	600/2500
2	15	West.	SK	500/1500
1	9	L-A	Baler	1750
4	10	G.E.	RC	1150
2	10	G.E.	CD-75	1150
1	10	Diehl		900
1	10	G.E.	CD-83	850
1	10	Roth		800
1	10	Diehl	LS-14	750
1	10	West.	Elevator	700
1	10	G.E.	CVC	700
1	10	West.	SK	600/1200
1	10	G.E.	RLC	500/1500
1	10	West.	SK	500/1500
2	10	G.E.	RF-10	400/1600
2	10	West.	SA	400/1200
1	10	West.	SK-90	400/1200
1	10	Diehl		200/247
1	7½	Sturt.	TF	3600
1	7½	El Dyn.	2S	1750
1	7½	G.E.	RC	1150
6	7½	West.	SK-40	1180
1	7½	G.E.	CO-1804	
1	8	L-A	Baler	1200
2	7½	West.	SK	850
2	7½	G.E.	RC	850
1	7½	West.	SK-60	850
2	7½	G.E.	RF-9	600/1800
1	7½	G.E.	RF-10A	600/1500
1	7½	West.	SK-90	650/1300
1	7½	El. Dyn.	3S	550/1650

230 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	7½	G.E.	RF-10	450/1800
1	7½	G.E.	RF-10	450/1600
1	7½	G.E.	RF	450/1800
2	7½	West.	SK-70	400/1600
1	7½	Al. Ch.		350/1050
1	7½	L-A	Baler	

110 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	45	G.E.	RC	1100
1	25	G.E.	CD95	1150
2	10	Lincoln	I-SC	3500
1	10	L-A		3500
1	10	E. Dyn.	3S	1100
1	10	West.	SK-70	850
1	10	Reliance		400/1600
2	10	Diehl		230
1	7½	G.E.	CVC	725
1	7½	El. Dyn.	5S	450/900
1	7	El. Dyn.		600/1200

D.C. Generators

Kw	Make	Voltage	Ampere	Speed
300	Burke	250/125	1200	900
300	West. (2)	250	1200	900
250	G.E.	125	2000	720
100	G.E.	125	800	1150
100	Al. Ch.	250/125	400	1150
50	G.E. (2)	125	400	1150
50	G.E.	250	200	870
40	Rel. v.s.	250	160	1750
30	El. Dyn.	600	50	1150
30	G.E.	125	240	1150
30	G.E.	250	120	1750
25	G.E.	125	200	1150
20	West.	250	100	1150
10	West.	250	40	1150
10	West.	125	80	1150
7½	G.E.	250	30	1150
7½	West.	125	60	1150

AIR COMPRESSORS

12½"x12"	American
10"x6"	Gardner
9"x8"	Ingersoll Rand
9'x8"	Sullivan
7"x6"	Ingersoll Rand

D.C. to A.C. Generators
1 to 10 K.V.A.
115 and 230 V.D.C. to
1 ph. and 3 ph. 110-220
& 440 V. A.C.

THIS IS A PARTIAL LIST ONLY!

L. J. LAND & COMPANY

146 GRAND STREET, NEW YORK 13, NEW YORK

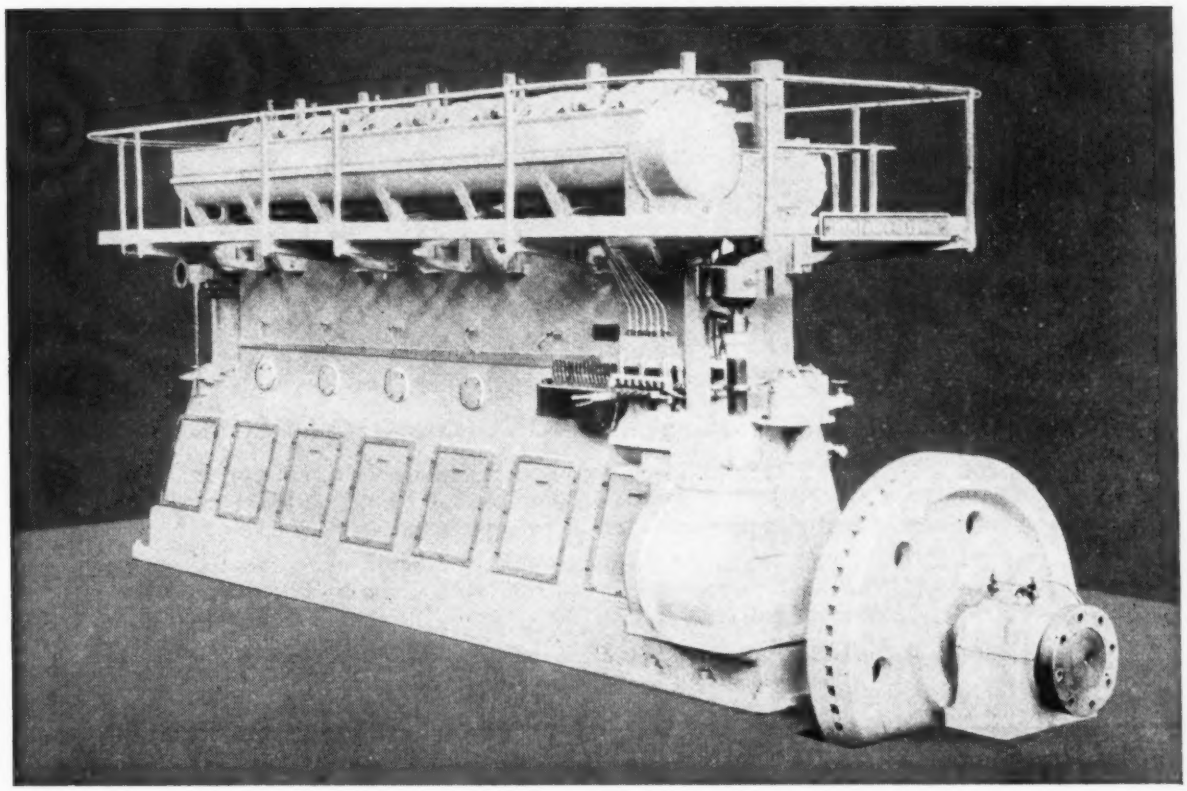
Established 1910 **CAnal 6-6976**

Boston, Mass.: 411 Atlantic Ave. Phone Liberty 4300

Reading, Penna.: 10th & Exeter Sts., Phone Reading 2-6866

ALCO DIESELS

8600 HP—10 UNITS
ONE OR ALL—TODAY



SEVERAL IMPORTANT OFFERINGS

3—1200 HP Alco (McIntosh & Seymour) Diesel Engines—Model 8B40—8 cyl. 20x24—4 cycle—air injection—300 RPM—direct connected to
3—1000 KVA—800 KW Westinghouse—ideal Generators—3/60/2300-4000 with exciters, switchboards and auxiliaries.—New 1931.

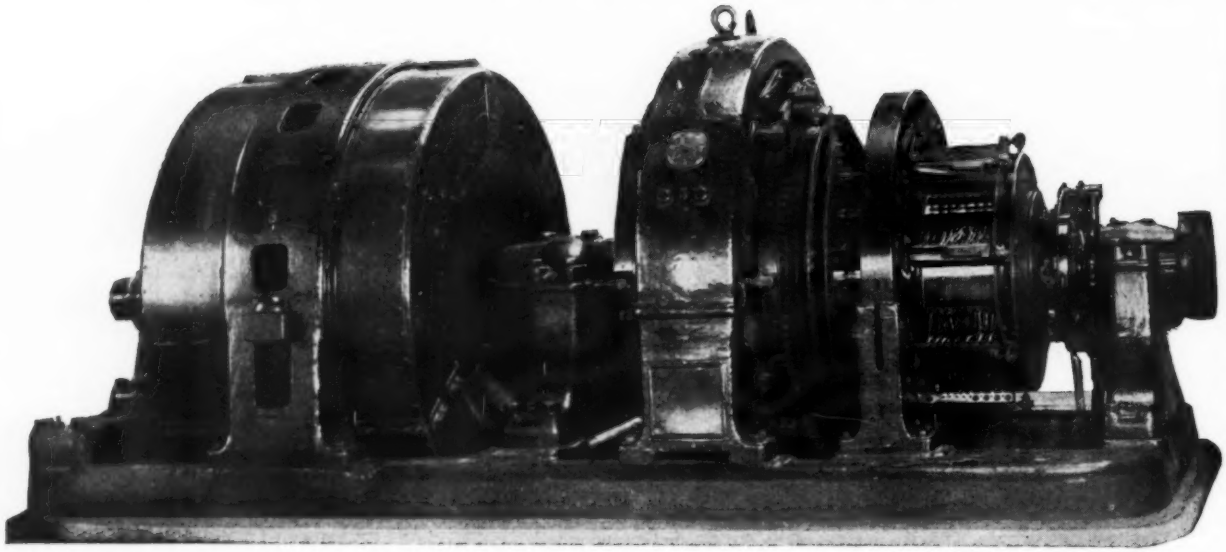
7—720 H.P. Alco Model 6B25 Diesel engine—6 cyl.—12½x13—4 cycle-solid injection—720 R.P.M.—direct connected to
7—625 KVA—500 KW General Electric Generators, 3/60/127/220. Self contained—radiator cooled—skid mounted—NEW.

2—375 HP Alco-Model 5B25—Diesel Engines—6 cyl., 12½x18, 4 cycle-solid injection—300 RPM—direct connected to
2—312 KVA—250 KW—Westinghouse Generators—3/60/240/480—Buffalo Evaporative cooling—switchboard and auxiliary—New 1938.

Rebuilt and Guaranteed
Running Inspection by Appointment

ROBERT SCHOONMAKER
Port Washington, Long Island, N.Y.
Phone Roslyn 1600

ELECTRICAL POWER MACHINERY



1800 KW GENERAL ELECTRIC SYNCHRONOUS MOTOR GENERATOR SET

1—1800 KW 50 deg. General Electric compound interpole direct current generator type MCF form L 275 volts 6550 amps. 600 RPM #1358377 mounted on common cast iron sub-base and direct connected to

1—2500 HP 85% P.F. 2400 KVA 50 deg. General Electric synchronous motor type ATI from C 3 phase 60 cycle 13200 volts (can be reconnected for 6600 or 2300 volts) 600 RPM #4097530

The above motor generator set is in excellent condition, complete with automatic switching equipment and available immediate shipment.

TURBINE UNIT
Condensing

3 phase 60 cycle

15000 KVA G.E.	6600 V. 185#
9375 KVA G.E.	2300 V. 180#
5000 KVA Wstgh.	2300 V. 160#
4375 KVA G.E.	2300 V. 175#
3750 KVA G.E.	2300 V. 200#
3125 KVA Wstgh.	600 V. 250#
3125 KVA G.E.	2300 V. 175#
2500 KVA G.E.	2300 V. 200#
1563 KVA Allis	2300 V. 210#
1250 KVA Wstgh.	2400 V. 240#
937 KVA G.E.	2300 V. 150#
750 KVA G.E.	2300 V. 150#
625 KVA G.E.	240 V. 200#
625 KVA G.E.	2300 V. 225#

TURBINE UNIT
Automatic Extraction

3 phase 60 cycle

1875 KVA Wstgh. 240 V. 400#
90# extraction
1250 KVA Allis 480 V. 250#
35# extraction
1250 KVA Allis 480 V. 150#
12# extraction
625 KVA Wstgh. 480 V. 250#
5# extraction

TURBINE UNIT
Non-condensing

3 phase 60 cycle

6250 KVA Allis 4600 V. 425#
185# back pressure
1875 KVA Wstgh. 240 V. 400#
90# back pressure
937 KVA Allis 2300 V. 200#
80# back pressure
625 KVA G.E. 240 V. 200#
50# back pressure
625 KVA Allis 240 V. 125#
2# back pressure
312 KVA C. W. Moore 240 V. 425#
18# back pressure
250 KVA Wstgh. 600 V. 150#
15 back pressure
250 KVA Wstgh. 480 V. 300#
30# back pressure

UNIFLOW UNITS
3 phase 60 cycle

1000 KVA Skinner 2300 V. 115#
750 KVA (2) Skinner 2300 V. 175#
750 KVA Chuse 2300 V. 175#
350 KVA Ames 2300 V. 150#
260 KVA Skinner 480 V. 150#
250 KVA Skinner 240 V. 145#
156 KVA (2) Skinner 240 V. 150#
150 KVA Ames 240 V. 150#

DIESEL UNITS
3 phase 60 cycle

575 KVA Rathbun 440 V. 300 RPM
300 KVA (3) Chic. Pne. 480 V. 720RPM
300 KVA Fair. Mor. 2400 V. 257 RPM
250 KVA DeLav. 480 V. 277 RPM
250 KVA Fair. Mor. 2300 V. 257 RPM
219 KVA DeLav. 4000 V. 300 RPM
150 KVA Fair. Mor. 2300 V. 257 RPM

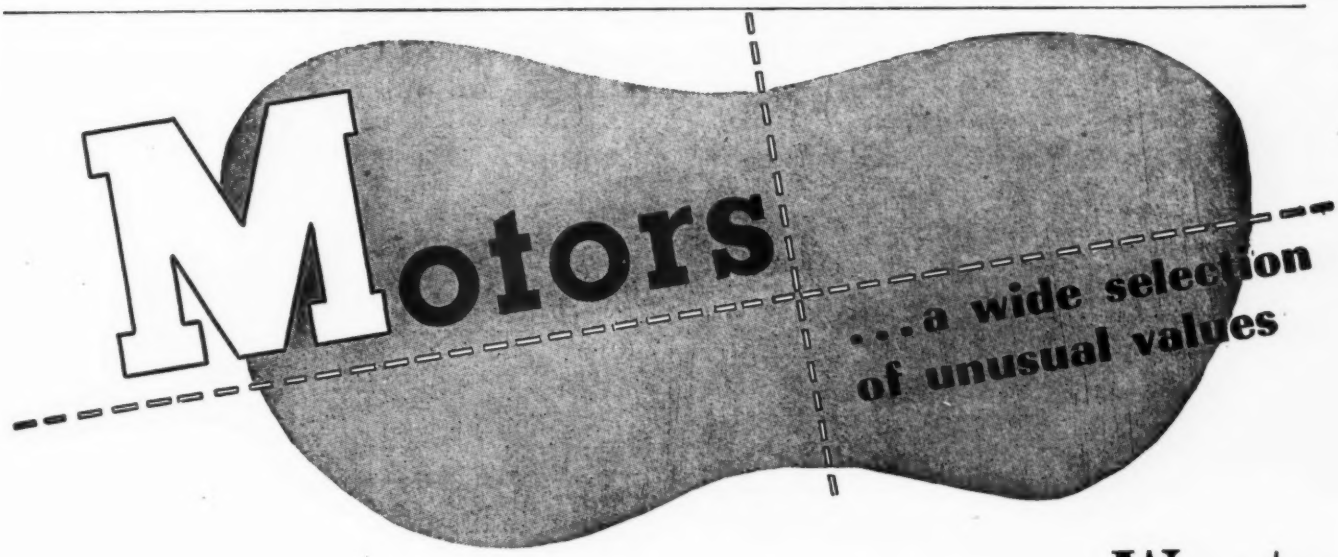
SPECIAL OFFERING

2—375 KVA Two unit (156 KVA and 219 KVA) Electric Machinery alternating current generators, 3 phase 60 cycle 240 volts 360 RPM direct connected to Skinner Vertical Universal Uniflow engines, two cylinders, 140-165# steam pressure, 0-7# back pressure.

Used only two winters—Excellent condition

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO



Listed below a few of the motors available in a hurry from Wente

SQUIRREL CAGE

3 Phase, 60 Cycle, 220/440 Volt.

Qu.	HP	Make	Type	Speed
1	150	Al. Ch.		1750
1	150	G.E. 2200 v.	IK	720
1	100	G.E. 2200 v.	IK	600
1	100	R'way 440v.		1200
1	100	West. 2200v.	CCL	1720
1	100	G.E.	I	340
1	100	G.E.	I	290
1	75	Lincoln	C10	1200
1	75	F.M. 550v.	H165C	900
1	75	Lincoln	IQ	600
1	75	G.E.	KT562	450
6	75	G.E. 440 v. new Ball Bearing	K	1800
1	50	G.E.	I	720
2	50	West.	MS 25 cy.	720
1	50	Wag.	BM	495
1	50	Al. Ch.		490
1	40	Triumph	B12	850
2	35	Al. Ch.	2 ph.	865
2	35	Al. Ch.		865
1	35	Ft. Wayne	2 ph.	900
1	35	G.E.	25 cy.	730
1	30	F.M. 2200v.	HD12B	3600
1	30	Al. Ch.		1200
1	20	Louis A.	KH	1170
1	30	West.	CCL	900
1	30	Wagner	22VBR	860
2	30	Al. Ch.	AN 2 ph.	860
1	30	Century	AS 25 cy.	720
5	30	West. new B.B. 440v.		1750
7	25	West. new B.B. 440v.		1160
6	25	G.E. B.B. 440v.		1160
1	25	R. & M.	K207	1750
1	25	Howell		1200
1	25	Lincoln		900
1	25	G.E.	KT332	900
1	25	Al. Ch.		860
1	25	Rel. (elevator) T. E.		750
1	25	Al. Ch.		720
1	25	G.E.	M10	720
1	25	West.	CS644C	690
1	20	West.	CCL	3600
1	20	Al. Ch.		1700
1	20	Century		1740
1	20	F. M.	KRV	1200
1	20	West.		1200
1	20	Wagner		1150
1	20	Ideal	A	1150
2	20	Wagner	HRP404	1060
1	20	Cleve.	M-147	900
1	20	Al. Ch.		860
1	20	R. & M.	K-207	900
1	20	West.	CS-644	870
1	20	West.	MS	900
1	20	F. M.	H	870
1	20	West.	CCL	580
1	20	Wagner	CM	445
1	15	West.	MS-4 (Elev.)	720
1	15	West.	CCL	1700
1	15	Wagner	13VRW	1725
1	15	Wagner	13VRW 2 ph.	1725
1	15	Cr. Wh.	115Q	1720
1	15	West.	CS-460C	1200
1	15	Wagner	15TCP-TEFC	1140
1	15	G.E.	KT512	875
2	15	West.	CS-573 25 cy.	725
2	15	West.	MS 25 cy.	725
1	15	West.	CS567C 25 cy.	715
1	15	West.	MS 25 cy.	600
1	10	Al. Ch.		3450
1	10	G.E.	KT302	900
1	10	West.	CS 25 cy.	725
1	10	West.	MS 25 cy.	720
2	10	West.	CS473C 25 cy.	615
10	10	West. new B.B. 440v.		1750
1	7½	Wagner	MCP-365	1140
1	7½	Lima	RS-405 b.b.	514
110	5	Wagner new B.B.S.P. 440 v.		1750

SLIP RING

3 Phase, 60 Cycle, & Syn.

Qu.	HP	Make	Type	Speed
1	443	El. Mach.		900 Syn.
1	275	Al. Ch.		1170
1	200	F. M.	BV	600
1	200	Al. Ch.		1175
1	200	Westg. 2200 v.	600 Syn.	
2	75	F. M. 2200v.	BV-H16B	1800
1	75	G.E.	MT552	865
1	50	G.E.	IM	1150
1	50	Triumph	C12	1150
1	50	G.E.	IM	900
1	50	G.E.	IM 25 cy.	700
1	50	Al. Ch.		690
2	40	G.E.	MT336	1200
1	40	Al. Ch.		1160
1	40	W'g 2200v.	CW	870
1	40	Westg.	CW-658-A	870
2	40	Al. Ch.		870
1	40	G.E.	MY-W	880
1	40	Westg.	C1753A 25 cy. cr.	730
10	35/15	G.E.	OMT336	1150/550
1	35	Al. Ch.	25 cy.	720
2	35	G.E.	IM	570
1	30	F. M.	AD Alt.	1200
1	20	Imperial	DW-D37	1800 Syn.
1	22	G.E.	ITC5011 (hoist)	680
1	25	Westg.	MW 322A	680
1	25	G.E.	MT342	600
1	25	G.E.	MT356	400
1	20	Triumph	C10	1200
2	15	G.E.	MT302	1200
1	15	G.E.	MT332	720
1	15	Westg.	CS	585
1	15	G.E.	MT556	280
3	10	Westg.	CW464A	1200
1	10	Westg.	HF	1140
1	10	W. E.		1200
1	10	G.E.	IM	1200
1	7½	G.E.	MT182	1750
1	7½	Westg.	CW-452A	1200

DC—230 Volt

Qu.	HP	Make	Type	Speed
1	75	Diehl	K11	700
1	100	G.E.	CD123	1200
1	60	Westg. 115v.	SK140L Bert.	1140
1	60	G.E.	EFI	1200
1	40	Rel. 440 v.	13LT Vert.	1750
1	40	Rel. 440 v.	230T Vert.	1130
1	25	C.W. 440 v.	CMC-EH Vert.	1150
2	40	Westg.	SK 123	1150
3	40	G.E.	RC 32	1100
8	40	Westg.	SK 140	775
1	35	R. C.	11B	1500
1	35	Al. Ch.		1200
1	35	G.E.	DLC 203	700
1	35	Westg.	SK 163 Vert.	300/1200
1	30	El. Dy.	158	625
1	30	Westg.	SK 110L	1150
1	30	Rel. 440 v.	131 T Vert.	1150
4	30	Reliance	92 TF	1750
1	27½	G.E.	CVC 116	1750
10	25	Westg.	SK 120	825
3	25	Westg.	SK 103	1150
1	25	Westg.	SK 90	1400
4	25	Westg.	SK 100 L	1150
1	30	G.E.	RO 51B	1150
1	25	Sprague		850/2000
1	25	Westg.	SK 123	550/1100
1	25	Al. Ch.	E 120	500/1500
1	25	G.E.	RF 12	400/1200
2	25	Westg.	SK	400/1200
1	25	J. & L.		625
2	20	Reliance	131T	1000
2	20	Diehl	X914A	500/1500
2	20	Westg.	SX113	500/1500
1	20	G.E.	RF12	250/1000
1	20	Lincoln	FXW B.B.	1800
1	20	Westg.	SK70L	1700
6	20	Cr. Wh.	CMC T.E.B.B.	1750
1	20	Cr. Wh.	CMC T.E.B.B.	1150
1	20	Westg.	SK93	1150
11	20	Reliance	92T	1150
1	20	Westg.	SK120 T.E.	1100
3	20	Westg.	SK100L	900
1	20	Watson	K	850
8	20	Reliance	131T	850
1	20	G.E.	RC30	750
1	20	Westg.	SK110L-115V	750

DC—230 Volt

Qu.	HP	Make	Type	Speed
4	20	Westg.	SK110L	750
1	20	Cr. Wh.	CW-CMC	600
1	20	Westg.	SK120	500
3	20	Al. Ch.	K	500/1000
1	15	Reliance	46TF	1750
2	15	Westg.	SK63	1750
1	15	Westg.	SK113 encl.	1750
1	15	G.E.	RC29A	1700
1	15	Westg.	SK93	1150
4	15	Westg.	SK83	1150
4	15	Cr. Wh.	CW-CCM T.E.	1150
1	15	Westg.	SK70L	1250
1	15	G.E.	CD83	1150
1	15	G.E.	RC10	1150
1	15	G.E.	RC29	1150
4	15	Westg.	SK93	850
4	15	Reliance	92TF	850
4	15	R. & M.		1000
1	15	G.E.	CVC-115	925
6	15	Westg.	SK90 Vert.	825
1	15	G.E.	RC29	750
6	15	Westg.	SK110L	675
1	15	Al. Ch.		1075
8	15	Reliance	131T	850
3	15	Reliance	92T	850/1700
1	15	Reliance	66T	800/1600
1	15	Westg.	SK	500/1500
2	15	Westg.	SK110L	400/1600
1	15	Triumph	32F	300/600
1	15	Triumph		225/900
1	12½	Westg.	SK	750/1500
7	10	Westg.	SK70	850
2	10	G.E.	RC29	850
2	10	Reliance	66TF	850
20	10	Westg. SK60L-Reliance 46TF	SK60-	1150
10	10	Cr. Wh.	CM-CHB T.E.B.B.	1750
4	10	Westg.	SK43	1700
1	10	G.E.	RF11	600/2400
4	10	G.E.	RF10	600/1800
6	10	Westg.	SK80L	500/1500

DC—230 Volt

Qu.	HP	Make	Type	R.P.M.
23	10	Al. Ch.		500/1000
1	10	G.E.	RF10	400/1200
2	10	Kimble	BA324 new B.B.	1750
1	10	Westg.	SK91	250/1000
21	7½	Westg.	SK32	1750
16	7½	Westg.	SK43	1150
20	7½	Westg.	SK60	850
20	5	Westg. & G.E.		1750
60	5	Westg. Rel.		1150
50	5	Westg.	SK43	850
75	3½	Westg.	SK33	850
80	3	Westg.	CD925	1725
120	3	Westg.	SK20	1550
60	2	Westg.	SK & CD	1150
50	2	Westg.	SK20	850
40	1½	Westg.	CD	1150
30	1½	Westg.	CD925	550/2200

2—200 KW, Westinghouse, 2200 to 250 Volt, DC, latest type variable voltage, 900 RPM, M-G sets, complete with control.

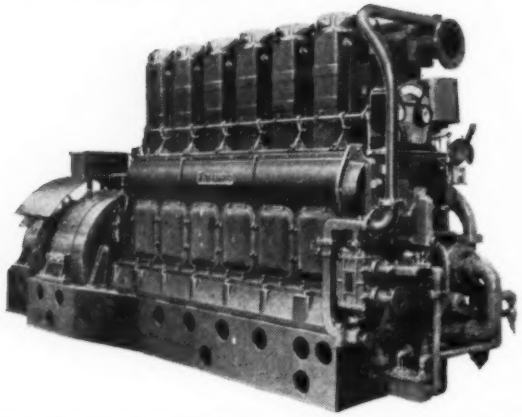
The Wente Electric Co.

Hamilton, Ohio

Rebuilt Motors & Generators

Since 1906

DIESEL POWER



DIRECT CURRENT GENERATOR

250 KW Elliott Generator. Direct current 120/240 volts. 3 wire 40° C. Compound wound direct connected to

450 HP Enterprise Diesel Engine, Type DSG-6, 450 RPM, 6 cylinder. 12" Bore x 16" Stroke.

OTHER IMPORTANT DIESEL POWER OFFERINGS FROM STOCK

GENERATOR SETS

3 phase, 60 cycle

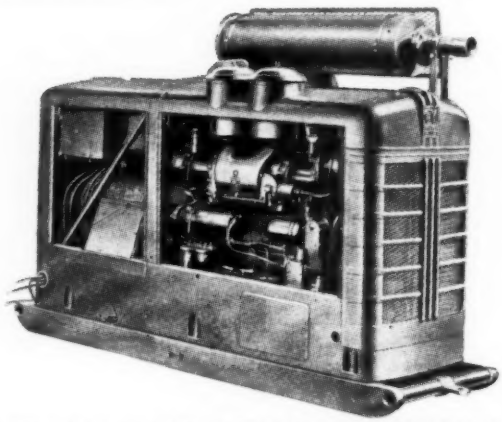
1500 KW	FAIRBANKS MORSE	2300 V
1000 KW	NELSECO	2300 V
500 KW	SUPERIOR	2300 V
350 KW	DE LA VERGNE	2300 V
300 KW	GMC	127/220 V
300 KW	NELSECO	2300 V
260 KW	McINTOSH & SEYMOUR	240 V
250 KW	McINTOSH & SEYMOUR	240 V
240 KW	FAIRBANKS MORSE	2400 V
130 KW	FAIRBANKS MORSE	2400 V
125 KW	BUCKEYE	240 V
100 KW	SUPERIOR	240 V
75 KW	BUCKEYE	240 V
50 KW	INTERNATIONAL	127/220 V
30 KW	INTERNATIONAL	127/220 V
15 KW	INTERNATIONAL	127/220 V

PORTABLE POWER UNIT

150 HP	BUDA	1200 RPM
130 HP	CATERPILLAR	1000 RPM
100 HP	INTERNATIONAL	1200 RPM
65 HP	INTERNATIONAL	1200 RPM
60 HP	FAIRBANKS MORSE	1200 RPM
43 HP	INTERNATIONAL	1200 RPM
30 HP	INTERNATIONAL	1200 RPM
18 HP	LISTER	1200 RPM
15 HP	GENERAL MOTORS	1200 RPM

GENERATOR SETS

250 KW	ENTERPRISE	120/240 V
60 KW	GMC	120 V
60 KW	BUDA	120 V
15 KW	HILL	250 V
15 KW	HILL	120 V



60 KW A.C. GMC DIESEL GENERATOR SET

NEW

60 KW General Electric Generator — 3 phase 60 cycle 127/220 volt. 1200 RPM—direct connected to—

90 H.P. General Motors Corp. Model RC-38 4¼" Bore x 5' stroke. Complete with Radiator Switchboard and Auxiliaries —

Immediate Delivery—In Stock—

ADVISE US OF YOUR POWER REQUIREMENTS

WRITE ***WIRE*** ***PHONE***

A. G. SCHOONMAKER COMPANY

DIESEL ENGINES

POWER & CONSTRUCTION EQUIPMENT

50 CHURCH ST., N. Y. 7, N. Y. *Business Est. 1898* ***Phone: WOrth 2-0455***

.....you don't have to wait twenty-eight months--

.....you can get delivery now--

.....you can install and obtain the operating economies you've been planning--

(There is reputable power apparatus available)

These turbo-generators are sound.

300 KW Condensing 1929 factory rebuilt—surf. condenser—240 V.
1000 KW Extraction Condensing 200# 100° 15# ga. Extr. rebuilt
500 KW Single Wheel reentry NC—1932—2400 V.
5000 KW Topping unit 450# 750°—fairly modern—adapt to NC
12,500 KW Condensing 200# 100° surf. condenser—very good
3 unit plant 30,000 KW 450# 750° T.T. (Topping unit takes 450#)

There are a few freq's (60/25 cycles—true)

One 500 KW, a couple 1500's, a 2500

These boilers have been checked for internal integrity.

2—329 HP Union Iron Type L—200#—stokers, plant complete—1937
4—460 HP Stirling—B&W—225#—stokers—1925
1—500 HP Stirling—200#—stoker—1935
2—600 HP Wickes 3 drum—250# 125°—stokers—1930—ins. approved
2—750 HP Stirling B&W—250# 150°—stokers—'29 & '37
1—650 HP 400# D&S—no firing—1930
1—70,000# Stirling—200# 100°—pulverizer fired—1918—rebuilt 1940
2—90,000# Box Header—250# 125°—pulverizer fired—1925—ins. approved
1—160,000# combustion—200# 100°—pulverizer fired—1929

And a few good HRT'S and refactory lined firebox oil field type boilers.

2—150 HP Erie City HRT's 125# Alowed—stokers . . . 4—120 HP 200# Oil Field—built 1928
2—150 HP 350# (N.B.) Oil Field built 1945 . . . 3—110 HP 200# Kewanee (N.B.) built 1928

Diesel equipment is—at least—timely.....and will be thru '47.
These are sound.

Complete plant—2300 KW—Utility maintenance (see 1st two items below) 60/3/2400 V.
2—575 HP 400 KW McIntosh-Seymour Built '24—Standby maintenance from '31
2—1200 HP 850 KW McIntosh-Seymour Built '29—Standby maintenance from '31
1—300 HP 200 KW Superior 60/3/480 Built since '30 with auxiliaries
1—300 HP 200 KW McIntosh 60/3/2300 Reported good.
2—New 300 HP 200 KW F/M 60/3/240
1—180 HP 120 KW Worthington 60/3/440 with auxiliaries
1—150 HP 100 KW F/M 60/3/2300 Built '27
Plant 2—Wintons Built '36 & '37 85 KW & 95 KW 60/3/240 with auxiliaries
Power Units, 1 new F/M 180 HP 325 RPM; 1—Reconditioned Enterprise 750 HP 327 RPM Built '38; 1 F/M 360 HP 325 RPM Built '28
D.C. unit 300 HP 200 KW Worthington Built '34 250 volts All auxiliaries

....and now is the best time to sell your equipment:

PAUL STEWART & CO., INC.

UNION TRUST BUILDING **CINCINNATI 2, OHIO**

Over 50 Years of Service

MOTORS—M. G. SETS—CONTROL

In Stock—Immediate Shipment—Rebuilt & Guaranteed

230-VDC. Crane & Mill Motors

	H.P.	Make	Type	R.P.M.
(6)	3	G.E.	C.O.-1803	750
(3)	5	G.E.	MD.-101	800
(1)	6	G.E.	C.O.-1805	1150
(1)	7½	G.E.	C.O.-1804	720
(1)	7½	Westghse	K-4	900
(1)	7/10	G.E.	M.D.-102 (back axle)	1025/800
(1)	9	G.E.	M.D.-102 (back axle) (C.P.)	975
(1)	10	G.E.	C.O.-1805	925
(1)	12/16	G.E.	M.D.-103	875/725
(1)	12/16	G.E.	M.D.-103 (back axle)	875/725
(5)	14/19	C.W.	B.W. (back axle)	675/560
(5)	14/19	C.W.	B.W.	675/560
(1)	15	Westghse	H.K.-5	700
(5)	15	Westghse	K-5	630
(4)	15	Westghse	MCA-30	600
(1)	20	Westghse	H.K.-6	650
(1)	25	G.E.	COM-1828 (C.P.)	850
(2)	27½	Westghse	K-7	535
(1)	30/45	G.E.	M.D.-104½ (C.P.)	625/500
(1)	30/45	C.W.	Size D.W.	620/520
(2)	40	Westghse	MCA-50	440
(1)	40	Westghse	MCB-50	440
(5)	45	G.E.	MD-104½	500
(1)	50	G.E.	MD.-105 (C.P.)	470
(1)	50	G.E.	C.O.-1829 (C.P.)	650
(1)	50	G.E.	MD.-105 (back axle)	475
(1)	52	Westghse	K-10	740
(1)	52	Westghse	K-10 (back axle)	740
(2)	54/80	C.W.	Size F. W.	575/480
(5)	65	Westghse	MCB-60	425
(2)	65	G.E.	C.O.-1811 (C.P.)	800
(2)	85	G.E.	M.D.-106	460
(2)	85/110	G.E.	M.D.-107	500/450
(3)	90	Westghse	MCB-70	400
(2)	90	Westghse	MCA-70 (C.P.)	475

(All above series wound except where C.P. compound wound")

MOTOR GENERATOR SETS

1—200 K.W., 250-275 V DC. Allis Chalmers, factory built set with 288 HP. Syn. motor, 80% P.F., 440/3/60 cy. A.C. & D.C. panel, O.C.B. & starting equipment.

1—17 K.W., 250 V DC. Electric Dynamic Generator, 25 HP. Westghse SQ. CG. motor, 1800 RPM., 220/440 V., 3-Ph., 60-CY. & motor comb.

230-VDC, Series Wound Armatures

1—G.E. C.O. 1804; 1—C.O. 1809; 1—C.O. 1811; 2—Westghse K-2; 1—K-7; 1—K-9.

230-VDC. Reversing Drum Controllers

Qu.	H.P.	Make	Type
1	2½	P&H	VC-1
1	5	P&H	HC
1	10	Westghse	116798-B
1	15	C.H.	Z-40116
1	15	G.E.	B-113D (Dyn.)
1	20	G.E.	R-171-A
1	15	EC&M	Dinkey V-2
1	10	Westghse	C18300-8303
2	25	EC&M	Dinkey V-2
1	30	C. H.	C-2
2	40	EC&M	Dinkey V-2
1	50	EC&M	Drum (Dyn.)
1	50 (new)	Euclid	D-802875 (Dyn.)
1	50	G.E.	R-164-A
1	50	G.E.	R-156-P
8	35/50	G.E.	R-177-A

(6 to 8 BANKS RESISTANCE WITH EACH)

ELECTRIC BRAKES (230 VDC.)

Qua.	H.P.	Make	Type	Wheel
1	5	C.H.	Series	8" x 3"
1	6	C.H.	TKI-48	
1	30	G.E.	CR-9510	11" x 5"
1	30	G.E.	CR-9511	12" x 5"
1	30	Westghse	D.I.	
1	50 (new)	Clark	Series	18" diam.
2	100	Clark	Shunt	24" diam.

VARIABLE SPEED MOTORS 230-VDC.

	H.P.	Make	Type	RPM.
(1)	2	G.E.	RLC-111 (SH.)	500/1500
(1)	3	G.E.	CR-3	500/1500
(1)	3 (Drip-proof B.B.)	Reliance	14T (SH.)	1200/3000
(1)	5	G.E.	RLC-115 (SH.)	250/1000
(1)	5	G.E.	RF-9 (SH.)	450/1350
(1)	5	Westghse	SK-33 (SH.)	1150/1650
(1)	6	G.E.	RF-9 (SH.)	450/1350
(1)	7½	Reliance	78T (SH.)	300/1200
(1)	7½	G.E.	RF-10A (SH.)	450/1350
(1)	7½	Westghse	SK-70	600/1800
(1)	7½	Westghse	SK-70	600/1000
(1)	7½	Westghse	SK-60L (C.P.)	650/1300
(1)	7½	Westghse	SK	850 1700
(1)	8	Westghse	SK-100L (SH.)	300/1200
(1)	8½	G.E.	RF-9 (SH.)	600/1800
(1)	10(115-V.)	Elec. Dy.	7½-S	250/1000
(1)	10	Westghse	SK-80L	900/1500
(1)	10	G.E.	CD	850/1250
(1)	10/15(new)	Allis-Ch.	EB-100 (SH.)	575/1725
(1)	10	Westghse	SK	600/1500
(1)	12	Westghse	SK	600/900
(1)	15	Westghse	SK (SH.)	400/1600
(1)	15	Westghse	SK-100L	450/1500
(1)	15	Reliance	131-T (SH.)	600/1500
(1)	19	Westghse	SK-100L(C.P.)	600/1200
(2)	20	G.E.	RLC	600/1200
(1)	20	G.E.	RLC-702	250/1000
(1)	20	Triumph	Comp.	250/1000
(1)	20	Westghse	SK	650/2200
(1)	25	G.E.	CD-128Y(SH.)	200/800
(1)	25	G.E.	RF-13 (SH.)	400/1200
(1)	25	Reliance	F-3 (C.P.)	500/1500
(1)	30	Westghse	SK-163 (SH.)	400/1200
(1)	35	Westghse	SK-160 (C.P.)	500/750
(1)	45	Reliance	310-T (SH.)	500/1500
(1)	50/60	G.E.	RLC-205(SH.)	400/1200

2—150 HP., Electro Dynamic Variable Speed, 3-bearing, Frame 75-S, Comp. Interpole, 250/500 RPM., 2 hrs. 185 HP., with Monitor Control Panels, built in Resistance, Auto 4-step acceleration, non reversing, P.B. control.

SLIP RING MOTORS (Crane Type)

220/440-V., 3-Ph., 60-Cy.

	H.P.	Make	Type	R.P.M.
(2)	2	G.E.	MTC-5140	1200
(1)	2	G.E.	MTC-5140 (550-V)	1200
(1)	11	G.E.	IK-5008	820
(1)	11	Louis Allis	S.R.	1200
(1)	15	G.E.	MTC-5302-Y (enclos.)	830
(1)	35	G.E.	MTC-5336-Y (enclos.)	550
(1)	37	G.E.	ITC-5011	1200
(1)	35	Westghse	C.I.	720
(1)	50	Westghse	C.I.-6440	870
(1)	50	G.E.	ITC-5013	600
(1)	200	Westghse	M.W.	580

220/440/550-V., 3-Ph., 60-Cy.

	H.P.	Make	Type	RPM.
(1)	25	G.E.	MTC-5523	680
(1)	27	G.E.	ITC-5012	500
(2)	37	G.E.	ITC-5011-A	700
(1)	50	G.E.	MTC-5537	750
(1)	80	G.E.	MTC-5547	715

Constant Speed 230-VDC. Motors

	H.P.	Make	Type	RPM.
(2)	2	Al.-Ch.	E-50	1750 SH.
(1)	3	Reliance	T-224	3500 SH.
(1)	3	G.E.	CD-55	1150 SH.
(1)	5	Westghse	SK-33	1150 SH.
(2)	5	Westghse	SK-40	850 SH.
(1)	5	G.E.	RC-27A	1150 SH.
(1)	5(new	Al.-Ch.	EB-55	1750 SH.
(2)	7½	Westghse	SK-60	850 C.P.
(5)	7½	Westghse	SK-43	1150 SH.
(1)	7½	Westghse	SK-5L	550 C.P.
(1)	7½	Westghse	SK-40 (115-V.)	1150 SH.
(1)	10(new)	Al.-Ch.	EB-80	1150 SH.
(1)	10	Westghse	SK-50L	1300 SH.
(1)	15	Al.-Ch.	Shunt	800
(1)	15	Westghse	SK-100L	850 SH.
(1)	15	C.W.	CCM	800 C.P.
(2)	20(new)	Elec Dy.	182N (Enc.) (B.B.)	1500 C.P.
(1)	25	Westghse	SK-100L	1100 SH.
(1)	30	G.E.	DLC-201	1100 SH.
(1)	35	Westghse	SK-130	850 SH.
(1)	50	Westghse	SK	1700 SH.
(1)	75	Reliance	T	875/1200 C.P

SLIP RING (Constant Duty)

220/440-V., 3-Ph., 60-Cy.

	H.P.	Make	Type	R.P.M.
(1)	3	G.E.	M.Q.-1801 (2-PH)	1080
(2)	7½	G.E.	MT-201 (550-V)	1200
(1)	10	G.E.	I.Q. (2-PH)	1120
(1)	20	Westg	C.W.	900
(1)	38	G.E.	I	1200
(1)	100	G.E.	I.M.	860
(1)	200	Westg	C.W.	514
(1)	250	Westg	C.W.	435
(1)	500	Allis Ch.	Any	585
(1)	500	Westg	C.W.-2200 v.	360
(1)	600	G.E.	MT412X (2200 v.)	719
(1)	750	G.E.	MT414V (2200 v.)	709

(Above two motors have G.E. control CR-2016)

(1) 1200 Allis Chal. ANY 6600 v.) 300
(Primary and secondary liquid slip control)

(1) 1500 G.E. MT (2200 v.) 273
(G.E. C.R.-2016 control)

(1) 2500 G.E. MT-(6600-V) 257
(With primary and secondary liquid slip control)

SQUIRREL CAGE MOTORS

220/440-V., 3-Ph., 60-Cy.

(3)	5-B.B. F.M.	H-Frame-D (2-PH)	900
(2)	7½-B.B. F.M.	H-Frame-D (2-PH)	900
(1)	25 Westg	C.S.	900
(1)	25/12½ Westg	C.S.-404	1730/850
(1)	25 Burke	2-Phase	1800
(1)	25 Century	AS-30 (2-PH)	1155
(1)	25 Burke		1200

SYNCHRONOUS MOTORS
CONDENSERS

(1)—750-KVA., G.E. Syn. Condenser type A.T.I., 600-V., 3-Ph., 60-Cy., 900-RPM., 8.5 K.W. Dir. Connected Exciter with complete control equipment.

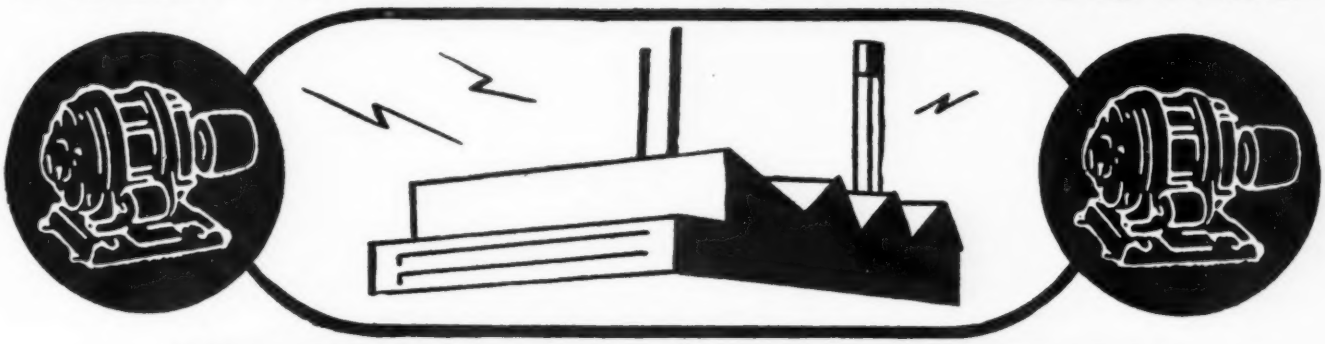
(1)—683-HP., G.E. Syn. Motor, type A.T.I., 600-V., 3-Ph., 60-Cy., 900-RPM., 80% P.F., Dir. Connected 8.5-K.W., exciter and complete control panels and starting equipment.

(1)—250-KVA Westgshe. Syn. Generator on 337-HP., Syn. motor. 2200-V., 3-Ph., 60-Cy., 600-RPM., belted exciter, control panels and starting equipment.

T. B. MAC CABE COMPANY

4312 CLARISSA STREET PHILADELPHIA, PENNA.

New Motors FOR INDUSTRY



TOTALLY ENCLOSED FAN COOLED

50—40 HP Howell Nema 504 440-60-3 900 RPM with starters
50—3 HP New GE 115 V 60 cy. 1 phase 1800 RPM Capacitors
50—150 HP 440-60-3 1800 RPM B.B. with starters

NEW — STANDARD OPEN SQUIRREL CAGE 3/60/220-440 B.B. — NEW

Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.
8	1	204	1200	6	10	324	1800	4	50	504	1200
6	1	204	1800	3	10	326	1200	1	60	504	1800
20	1½	204	1800	8	15	326	1800	1	60	505	1200
7	1½	224	1200	13	15	365	1200	4	75	505	1800
14	2	224	1800	7	20	364	1800	6	75	5084	1200
9	2	225	1200	7	20	404	1200	4	100	5084	1800
3	3	223	1800	16	25	365	1800	2	100	5084	1200
2	3	254	1200	10	25	404	1200	1	125	5085	1800
3	5	254	1800	5	30	405	1800	3	125	6085	1200
6	5	284	1200	9	30	444	1200	1	150	5085	1800
5	7½	284	1800	6	40	444	1800	4	150	6085	1200
6	7½	324	1200	3	40	445	1200	2	200	6085	1800
				2	50	445	1800	2	200	6085	1200

NEW — TOTALLY ENCLOSED FAN COOLED 3/60/220-440 B.B. — NEW

Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.
10	1	203	1800	4	10	324	1800	6	50	445	1800
11	1	204	1200	4	10	326	1200	4	50	504	1200
6	1½	204	1800	8	15	326	1800	5	60	504	1800
20	1½	204	1200	1	15	365	1200	3	60	605	1200
5	2	224	1800	6	20	364	1800	3	75	505	1800
14	2	225	1200	10	20	404	1200	4	75	508	1200
10	3	225	1800	14	25	365	1800	3	100	508	1800
2	3	254	1200	20	25	405	1200	2	100	508	1200
1	5	254	1800	1	30	405	1800	2	125	6085	1800
4	5	284	1200	3	30	444	1200	2	125	6085	1200
6	7½	284	1800	4	40	444	1800	2	150	6085	1800
5	7½	324	1200	2	40	445	1200	2	150	6085	1200

NEW — D.C. MOTORS 230 VOLT — NEW

2 — ½ HP	Shunt SL.B	DP	TL204	690/2760	RPM	22 — 2 HP	Shunt BB	DP	225	1150	RPM
6 — ½ HP	Shunt BB	TE	T-224	690	RPM	13 — 2 HP	Shunt BB	DP	224	1750	RPM
21 — ¾ HP	Shunt BB	DP	T-225	690	RPM	3 — 2 HP	Shunt SL	DP	225	1150/2300	RPM
6 — ¾ HP	Shunt SL	DP	T-224	690/2760	RPM	5 — 3 HP	Shunt SL	DP	225	1150/2300	RPM
18 — 1 HP	Shunt BB	DP	T-204	1150	RPM	4 — 3 HP	Shunt BB	DP	225	1750	RPM
1 — 1 HP	Shunt SL	DP	204	1150/2300	RPM	3 — 5 HP	Shunt BB		254	1750	RPM
2 — 1½ HP	Shunt SL	DP	224	1150/2300	RPM	3 — 5 HP	Shunt BB	Semi Enc.	254	1750	RPM
3 — 1½ HP	Shunt SL	DP	225	690/2760	RPM	3 — 7½ HP	Shunt BB	Open	23-T	1750	RPM
20 — 1½ HP	Shunt BB	DP	204	1750	RPM	1 — 10 HP	Shunt BB	DP	34-T	1750	RPM
15 — 1½ HP	Shunt BB	DP	224	1150	RPM	1 — 7½ HP	Shunt BB	DP		400/1600	RPM

NEW — 100 HP and LARGER — NEW

200 HP	GE	Type M Slip	2200 V	1750 RPM		250 HP	AC	Type ABN	440 V	900 RPM	
200 HP	A&C	Type Art Sqc	2200 V	900 RPM		200 HP	GE	Type	440 V	900 RPM	
4-200 HP	Wag	Type RP2 Sqc	440 V	1800 RPM		100 HP	GE	Type FTR 556Y	440 V	900 RPM	Reb
125 HP	GE	Type IM Slip	440 V	720 RPM		200 HP	GE	Type	440 V	720 RPM	Reb

50 — 3 HP GE 115 V Only Capacitor 1750 RPM single phase 60 cycle

150 — ½ HP GE BB Nema 440/60/3/3600 75 — ¾ HP GE BB Nema 220/440/60/3

We have in stock 10001 items • Too numerous to list • Controls • MG sets • Slip Ring Motors • Oil switches, etc. We can serve you best if we know what your requirements are. We invite your inquiries.

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us if you don't see the item you need. This listing is only a part of our large stock.

M-G SETS

300 KW. Gen. Elec. type MPC gen. DC 170 volts 1760 amp. coupled to 450 HP G.E. motor DC 250 V. 1150 RPM (can furnish A.C. drive).
100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage 1-K motor 3-60-2200/4000 V.—1200 RPM.
60 KW Whse. SA gen. DC 250 V. coupled to 90 HP G.E. ATI synch. motor 3/60/220/440 V.
50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440.
40 KW Martin rotary converter, input 3/60/220 v., output DC 230 v., with panel.
37½ KVA Whse. AC gen. 3/60/240 V. coupled to 50 HP Whse. SK motor DC 230 V. 1150 RPM, 3 brg.
35 KW Gen. Elec. DLC gen. DC 250 V. to 50 HP AC motor 3-60-220/440 V.
30 KW Gen. Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v.
Others available—special units built to order.

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	300	Gen. Elec.	I-K	1800
1	200	G.E. 2200 v. 3brg.	I-K	600
1	200	F.M. b.b. 2200 v.	H	1800
3	165	Gen. Elec.	I-K	1800
1	150	G.E. 2200 v.	I-K	720
1	100	Allis Ch.	AN	600
1	60	Howell	SC	1200
1	60	Gen. Elec.	I-K	3600
1	50	Gen. Elec.	I-K	1200
1	50	Gen. Elec. vertical	KT	1200
2	50	Gen. Elec.	I-K	900
1	40	Allis Ch.	AN	1200
1	40	Gen. Elec.	I-K	900
2	40	G.E. vertical	KT532	1200
1	30	Wagner	22TBP	900
1	30	Gen. Elec.	I-K	720
1	30	Allis Ch.	AN	900
2	25	Gen. Elec.	I-K	1800
1	25	Gen. Elec.	I-K	600
2	20	Gen. Elec.	I-K	1200
2	20	Gen. Elec.	KT532	600
3	20	Diehl New b. b.	IN364	1800
1	15	Gen. Elec.	I-K	720

D. C. MOTORS

H.P.	Mfg.	Type	Volts	Speed
450	Gen. Elec.	MPC	230	1150
125	Whse.	SK	230	850
125	Cr. Wheeler	125H	230	500
100	Cr. Wheeler	101H	230	550
85	Cr. Wheeler	80H	230	700
75	Cr. Wheeler	125H	230	350/750
75	Whse.	SA	230	900
75	Whse.	S13	125	475
75	Gen. Elec.	DLC	230	400
65	Cr. Wheeler	65H	230	600
65	G. E. Northern	C	230	375/750
60	Diehl dynamom	R10	250	500/2000
50	Whse.	SK	230	1150
50	G. E. Sprague	LC	250	700
50	Whse.	SA	230	450/1350
50	Cr. Wheeler (5)	50H	230	700
40	Gen. Elec.	DLC	230	750
40	Roth	S	115	850
40	Whse.	SK	230	1700
35	Fair Morse	TRC	230	1150
30	Sprague	dynamom	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
25	Whse.	SK	230	950
25	Sprague dyna.	IC	115	700/1500
25	Gen. Elec.	FC32	230	800
25	Star b. b.	SB15	230	1750
20	Imperial int. dty.	D37	230	1200
20	Gen. Elec.	LC	230	375
20	Gen. Elec.	DLC	230	500/1500

25 CYCLE MOTORS

H.P.	Mfg.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
150	Whse.	HD sl. rg.	500
100	Whse.	CCL sq. cg.	500
50	Allis Ch.	ANY sl. rg.	1500
75	Gen. Elec.	I sq. cg.	750
30	Gen. Elec.	IM sl. rg.	750

SYNCHRONOUS MOTORS

H.P.	Mfg.	Type	Volts	Speed
750	Allis Ch.		220/400	1200
300	Whse.	ped.	220/440	900
250	Gen. Elec.	ATI	220/440	514
90	Gen. Elec.	ATI	220/440	1200
75	Ideal	SMS	220/440	1200

CENTRIFUGAL PUMPS

8" Alberger, 2000 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.
8" Worthington, 2000 gpm @ 200 ft.

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfg.	Type	Speed
1	300	Burke	EMV	225
1	250	Cr. Wheeler	SR	600
1	200	Burke	EMV	514
1	150	G.E. 2200 v. vert.	I-M	1200
1	150	Whse.	HF	600
1	75	Gen. Elec.	MT537	1800
1	75	Gen. Elec. 2200 v.	I-E13	1800
1	60	Whse. 2200 v.	CW657	1800
1	60	Gen. Elec.	I-M	720
1	50	Gen. Elec.	I-M	600
1	40	North'n	HW35A	1200
2	40	Gen. Elec.	MT532	1200
1	40	Fair Morse b. b.	HV	900
1	40	Whse.	CW	900
2	40	Gen. Elec.	M546	514
2	40	Allis Ch.	ANY	450
1	40	G.E. 550 v.	MT536	900
1	37	G.E. int. duty	ITC	600
1	35	Fair Morse b. b.	HV	1800
3	35	Lancashire b. b.	late	1800
1	30	Northw'n. b. b.	HW404	1800
2	30	Allis Ch.	ANY	900
1	25	Gen. Elec.	I-M	1200
1	25	Wagner	19TBR	1200
1	25	Whse.	CW	720

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec. 1 brg.	MPC	125/170	1150
75	Whse.	S	125	600
60	Whse.	SA	250	1200
60	Gen. Elec.	DLC	250	450
50	Cr. Wheeler	CC	125	1800
35	Gen. Elec.	DLC	250	900
30	Gen. Elec.	CD113	250/125	900
30	Lincoln b. b. 600 amp.		50	1200
25	Gen. Elec.	DLC	125	900
25	Gen. Elec.	RC	250	900
25	Whse. (3) b. b.	SL113	250	1800
20	Allis Ch. (2)		125	475
16	Cr. Wheeler	CCD	125	415

ALSO IN STOCK . . . OIL SWITCHES BLOWERS & FANS - SPEED REDUCERS

60 CYCLE A.C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
300	Whse.	ped.	240/480	900
300	Elec. Machy. 3 brg.		240/480	720
200	Gen. Elec.	ATB	2300	600
165	Elec. Machy.	BRKT	240/480	900
150	Allis Ch. 25 cycle		240/480	500
75	Whse.	G	2300	900
75	Gen. Elec.	ATB	240/480	1200
75	Ideal	SM	240/480	1200
10	Whse. (5) NEW	b.b.	240	1200

ARTHUR WAGNER COMPANY

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POWER PLANT EQUIPMENT

Special Offerings

TURBO-GENERATORS

1—3000 KW. 2300 V. Cond.
1—2500 KW. 2300 V. Cond.
1—1250 KW. 2300 V. Cond.
1— 250 KW. 240 V. N. C.
1—2000 KW. 600 V. Cond.
2—1000 KW. 2300 V. Cond.
2—600 KW. 4000 V. Cond.
1—500 KW. 440 V. N. C.
1—500 KW. 125 V. D. C.
1—375 KW. 440 V. Cond.
1—120 KW. 440 V. N. C.

ENGINE GENERATORS

1—540 KW. Uniflow 480 V.
1—150 KW. 480 V.
1—600 H.P. Uniflow Eng.
1—168 KW. 550 V.
2—280 KW. 440 V.
1—600 KW. 2300 V.

TURBINES ONLY

1—375 H.P. with gears
1—210 H.P. Terry 250#
1—100 H.P. G.E. with gears

BOILERS

1—1390 H.P. 400# Coal
1— 990 H.P. 200# Coal
1— 620 H.P. 200# Coal
3— 500 H.P. 160# Coal
1— 360 H.P. 190# Coal
2— 310 H.P. 250# Coal
2— 100 H.P. 100# Oil
2— 175 H.P. 200# Oil
1— 200 H.P. HRT 160#
5— 150 H.P.HRT 125#

MOTOR

1—200 H.P. Syn. 220 V.

AIR COMPRESSORS

2—3400 CFM 100# Motor
1—3000 CFM 100# Motor
1—1972 CFM 100# Motor
1—1573 CFM 100# Motor
2—1228 CFM 100# Motor
1— 511 CFM 100# Belted
1— 490 CFM 100# Belted
1— 600 CFM 350# Steam
1—5000 CFH 600# Belted
1—1000 CFH 3000# Belted

FORCED DRAFT FANS

2—Coppus 28"—15000 CFM at 4" S.P. Turbine Driven New, never used

8—Coppus 26"—11500 CFM at 4" S.P. Turbine Driven condition—good.

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The Buyer Must Be Satisfied—Always

SYNCH. CONVERTERS

500 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

300 KW G.E. SYN. 600 V. 2300/4000 A.C. 1200 RPM
150 KW G.E. SYN. 250 V. 2300/4000 A.C. 900 RPM
150 KW G.E. SYN. 600 V. 2300/4000 A.C. 1200 RPM

Each unit listed above is owned by us and is available now for immediate purchase

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Incorporated

502 Grant Building, Pittsburgh, Pa.

AIR COMPRESSOR

625' Ingersoll-Rand type XRE, 125 lbs. pressure, direct connected General Electric 100 H.P. synchronous motor 220-440 volt, A.C. Starting equipment.

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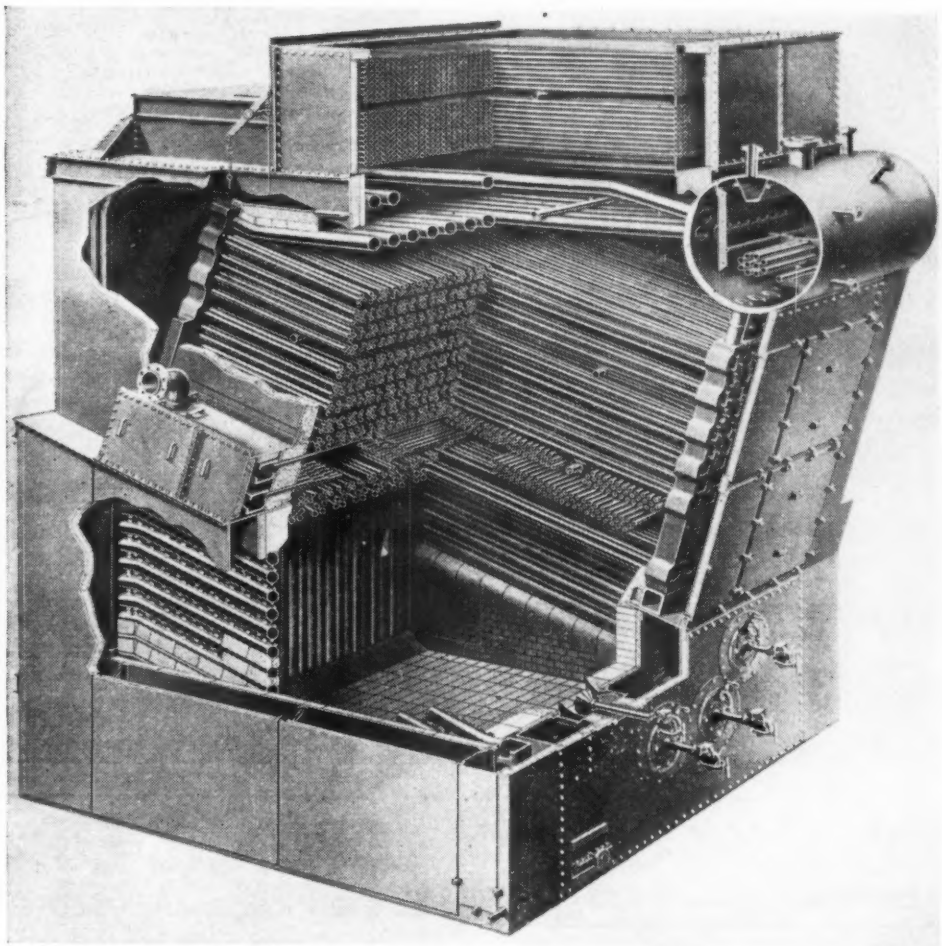
IMMEDIATE DELIVERY

MARINE SECTIONAL WATERTUBE HEADER TYPE

Steel Encased • • Superheater • • Water Walls • • Oil Fired

450 Lbs. Pressure • • 32,056 Lbs. Steam Per Hr. • • Air Heater



PRESSURES:
(Per Sq. Inch)

Steam Drum	500
Steam Drum (Operating)	459
Superheater Outlet	450

TEMPERATURES:
(deg. F. Normal)

Sup. Steam	730
Feed Water	300
Air Heater Gas Outlet	340
Air to Burners	330

EVAPORATION RATE:
(lb. per hr. actual)

Normal	32,056
Overload	44,436

HEATING SURFACES:
(Sq. Ft.)

Boiler and Water Walls	4,934
Superheater	748
Air Heater	2,468

Built By Combustion Engineering Co. For Government

ABOVE IS A CUTAWAY VIEW OF ONE OF THESE BOILERS

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Only 6 Boilers Available

KNOCKED-DOWN-COMPLETE PACKAGE POWER GENERATING UNIT READY FOR YOUR IMMEDIATE INSTALLATION UNDER COMPETENT SUPERVISION FURNISHED BY THIS COMPANY

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THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.

1—22500 KW General Electric Cond.
1—15300 KVA Westinghouse Cond.
2—12500 KW General Electric Cond.
1— 7500 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 3750 KVA Westinghouse Extrac.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Extrac.
1— 937 KVA General Electric Cond.
1— 375 KVA General Electric Cond.
1— 6250 KVA Allis Chalmers Topping

D. C. TURBO UNITS

1—250 KW Westinghouse, 120/240 V.
1—125 KW General Electric, 125 V.
1— 75 KW General Electric, 125 V.
1— 50 KW Westinghouse, 125 V.

STEAM ENGINE UNITS—60 Cy.

1—625 KVA Ames Uniflow
2—480 KVA Skinner Uniflow
1—375 KVA Harrisburg Uniflow
1—325 KVA Skinner Uniflow
1—300 KVA Skinner Uniflow
1—150 KVA Ames Uniflow

D. C. STEAM ENGINE UNITS

1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—250 KW Ames Uniflow 250 V.
1—125 HP Ridgway 4-valve 250 V. 3-wire

DIESEL ENGINE UNITS

1—625 HP Worthington, 240 V. 60 cy. gen.
1—440 HP Nordberg, 250 V. gen.
2—400 HP LeRoi RX1SV (gasoline) eng. only
1—375 HP McInt. & Sey., 240 V. 60 cy. gen.
1—300 HP McInt. & Sey., 480 V. 60 cy. gen.
1—270 HP DeLaVergne, 4000 V. 60 cy. gen.
2—250 HP Gen. Motors, 450 V. 60 cy. gen.
1—150 HP Buckeye 400 RPM engine only
2—125 HP Winton, 240 V. 60 cy. gen.

WATER TUBE BOILERS

2—1373 HP B. & W. 230-lb., Oil Fired
1—1320 HP Springfield 400-lb., Pulverizer
2— 617 HP Wickes 250-lb., Bent Tube
1— 607 HP Wickes 250-lb., Stoker
6— 600 HP B. & W. 200-lb., Stokers
2— 600 HP Springfield 200-lb., Stokers
2— 568 HP Erie City 460-lb.
5— 492 HP Heine 180-lb., Stokers
2— 481 HP Springfield 225-lb., Pulverizers
2— 323 HP. Springfield 225-lb., Stokers

SYNCHRONOUS MOTORS

1—1700 HP West. 60 cy. 2300 V. 300 RPM
1— 500 HP Al. Ch. 60 cy. 2300 V. 450 RPM.
1— 300 HP G.E. 60 cy. 2200 V. 1800 RPM
1— 200 HP Ideal 60 cy. 4000 V. 514 RPM
2— 200 HP Burke 60 cy. 2300 V. 600 RPM
1— 100 HP G.E. 60 cy. 2300 V. 240 RPM (Super)
1— 100 HP G.E. 60 cy. 4000 V. 1800 RPM

INDUCTION MOTORS—60 Cy.

1—1000 HP West. slip-ring 2200 V. 300 RPM
1— 500 HP G.E. slip ring 2200 V. 1800 RPM
1— 500 HP West. sq. cage 2200 V. 1800 RPM
1— 500 HP G.E. slip ring 2200 V. 3600 RPM
1— 400 HP G.E. sq. cage 2200 V. 600 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
1— 250 HP F.-M. slip ring 220 V. 1800 RPM
2— 120 HP G.E. sq. cage 220 V. 3600 RPM

MOTOR GEN. SETS—60 Cy.

1—1000 KW General Electric 600 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 150 KW General Electric 15 V. DC
1— 100 KW Westinghouse 125 V. DC
1— 50 KW Westinghouse 250 V. DC

ROTARIES—60 Cy.

2—2800 KW General Electric 300 V.
1—2000 KW General Electric 600 V.
2—1750 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
1— 500 KW General Electric 250 V.

FREQUENCY CHANGERS

1—2150 KVA G.E. 25/62½ cy. 750 RPM
1—1875 KVA G.E. 25/60 cy. 300 RPM
2—1500 KW West. 25/60 cy. 300 RPM
2—1000 KVA G.E. 25/60 cy. 300 RPM
1—1000 KVA Al. Ch. 25/62½ cy. 375 RPM
1— 938 KVA West. 25/62½ cy. 750 RPM
1— 600 KVA G.E., 60/25 cy. 300 RPM

TRANSFORMERS—1 Ph. 60 Cy.

4— 6667 KVA G.E. 79860/138,000-34500 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
4— 1500 KVA G.E. 66-13.2/4.6/2.3 KV
3— 750 KVA Pitts. 66000-33000 V.
3— 600 KVA West. 66000-2300 V.
3— 100 KVA G.E. 66000-6900/11000 V.
2— 7500 KVA G.E. 33000-13800 V. 3 ph.
4— 1500 KVA G.E. 33-13.2/4.6/2.3 KV
3— 150 KVA G.E. 33000 2300 V.
6— 100 KVA G.E. 33000-2300 V.
3— 75 KVA Moloney 33000-2300 V.
2—10000 KVA West. 26400-4560 V. 3 ph.
1— 6000 KVA West. 26400-4560 V. 3 ph.
2— 1000 KVA G.E. 23000/11500-575 V.
1—10000 KVA West. 13200-4560 V. 3 ph.
3— 600 KVA Moloney 13200-2200 V.
2— 1000 KVA G.E. 11500-23000-575 V.
3— 500 KVA Pitts. 6600-2300 V.
3— 150 KVA G.E. 4150-220 V. 3 ph.
3— 250 KVA Al. Ch. 2300-230/460 V.
3— 30 KVA West. 440-220/110 V.
4— 25 KVA West. 440-220/110 V.

OIL CIRCUIT BREAKERS

1— 400 A. 37 KV G.E. FK0136	Outdoor
2—1000 A. 30 KV Kelman CB76	"
1— 400 A. 25 KV G.E. FK-136	"
4— 600 A. 15 KV G.E. FHK0138-24BS	"
1— 600 A. 15 KV G.E. FKO-37	Pole type
1— 600 A. 15 KV West. O-221	Outdoor
2— 400 A. 15 KV G.E. FHK0136	"

PARTIAL LIST — WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street New York City 7, New York

ELECTRICAL EQUIPMENT

REBUILT AND GUARANTEED—PROMPT SHIPMENT

MOTORS - GENERATORS - MG SETS - TRANSFORMERS - CONTROLS

SPECIAL OFFERINGS

VARIABLE VOLTAGE DRIVES

10—40 HP, General Electric Variable Voltage Ward Leonard Drives consisting of:

1—40 KW, 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators with exciters.

1—40 HP, 250/1500 RPM, Type CD-1441 DC Motor.

2—Auxiliary, 5 HP, 1750 RPM Type B-284 DC Motors.

1—Enclosed magnetic control providing jog forward, jog reverse, run, fast, slow, and stop. Complete with motor operated field rheostat

NEW 21—Leland, 2.5 KVA, 120 Volt, 1800 RPM, 60 cycle, Single Phase, Type AG, Frame 50, Form BOWJH, Continuous, self-excited A-C Generators

NEW 500 VOLT ADJUSTABLE SPEED D.C. MOTORS

Qu.	H.P.	Speed	Make	Type
4	7½	450/1800	G.E.	CD-85 (1 Hr.)
4	60	400/1600	G.E.	CD 1446-AL (1 Hr.)

NEW 25—Allis-Chalmers, 10 H.P., 1200 R.P.M., 230 Volt, D.C., EB-80, Dripproof, 40°, Ball Bearing.

NEW 1—200 HP, 2960 RPM, 3 phase, 50 cycle, 500 Volt, Westinghouse Type CS-8120 TEFC
2—250 HP, 296 RPM, 3 phase, 50 cycle, 220/380 Volt, (or 360 RPM, 3 phase, 60 cycle, 440 volt) Westinghouse Wound Rotor Type CW-20-53-15

NEW TRANSFORMERS

3—Moloney, 10 KVA, Type CL-2, Continuous 55°, 2400/4160 Volts Primary 120 Volts Secondary, Single Phase, 60 Cycle, OISC, Outdoor, With 2 High Voltage Bushings and Taps.

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All makes & sizes for prompt shipment several attractive assorted sizes.

SPECIAL OFFER
400-HP . . . 175 lbs. Stirling Boilers
3—250 HP Heine Water Tube Type

J. F. DAVIS CO.

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Telephone Harrison 0755

1500 WARD-LEONARD VOLTAGE REGULATORS,

Type 5660-ED-40043L-ED, 60 cycle, 120 volts. Brand New, in original Boxes. Special discount for quantity orders.

INDUSTRIAL TRADING CO.

30 Church St., New York 7, N. Y.

TURBO GENERATORS

750 KW., 3 ph., 60 cy., 480V. 3600 Allis Chalmers to a Moore extraction type Turbine with board.

500 KW., 3 ph., 60 cy., 480V. Westgh. non cond. Turbo Generator with board.

937 KVA., 3 ph., 60 cy., 2300V. Gen. Elec. cond. Turbo Generator.

ROTARY CONVERTER

1—1500 KW., 250 V. Westgh. complete.

1—156 KVA., 3 ph., 60 cy., 240 volt Gen. Elec. to an 8 cylinder Buffalo engine only 5 years old, little used.

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries.

What have you for sale?

KEYSTONE
Power Plant Equipment Company
8493 Hegermen St., Phila. 36, Penna.

NEW
CHRYSLER DIESEL
POWER UNITS

75 H.P. Model IND10-16, 6 Cylinder Electric Start. Includes: 4 Batteries, Radiator, Hood, Tool Kit, etc.

Immediate shipment—
Limited supply

Substantial discount to dealers.

ALJON ELECTRIC DIESEL CO.
151-55 Washington Street, Brooklyn 1, N. Y.
Warehouse 904-910 Pacific St. Brooklyn, N. Y.

87.5 KW G.E. M/G Set 250 Volts DC driven by synchronous motor .85 P.F. 1200 rpm complete with controls

Designers and Manufacturers of Special Electrical Equipment

ELECTRIC APPARATUS REPAIR CO.
1400 N. 6th Street, Phila. 22, Pa.

BOILERS

2 ERIE CITY longitudinal, box header water tube boilers with Type-E, stokers, 400 H.P. (each) headers are equipped with KEY CAPS—OHIO, PENN'A. & ASME Stamping.

H. P. BREARLEY
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DIESEL UNITS
925 HP Cooper Bessemer 240 V.—D.C.
300 KVA Fairbanks Morse 2400 V.
2—100 KW Chicago Pneu 250 V. D.C.
250 KW Busch Sulzer 240 V.
250 H.P. Busch Sulzer 257 rpm. Engine.
192 KW Mointosh Seymour 2300 V.
100 KW Busch Sulzer 2300 V.
2—11,500 & 20,000 Gal. Steel Tanks.
80 H.P. F.M. 300 rpm. Diesel Engine.
R. C. STANHOPE, Inc., 60 E. 42nd St., N.Y. 17, N.Y.

Generate your own power

NEW PORTABLE DIESEL GENERATOR SETS

for sale or rent

IMMEDIATE DELIVERY FROM STOCK

All brand new . . . International units . . . radiator cooled . . . fully enclosed . . . mounted on skids.

30 KW
TYPE UD 14
60 CYCLE 127/220 VOLT

SPECIAL PRICE **$4000.00**

These units may also be rented on exceptionally favorable terms.
For further information wire collect.

America's best inventory of new and rebuilt motors, generators, transformers, etc.

ELECTRIC EQUIPMENT CO.
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63 CURLEW STREET, P. O. BOX 51 ROCHESTER 1, N. Y.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 phase 25 cycle, 220/440 Volts

H.P.	Make	Type	Frame	RPM
5	West.	CS		750
5	West.	CS		750
5	West.	CS		750
5	West.	CS	453	750
5	West.	CS	453	750
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
10	G.E.	KT	312	750
10	Wagner	19TBM		750
10	Wagner	19TBM		750
10	Wagner	19TBM		750
15	G.E.	I Form K		750
15	West.	CS	4052	750
15	West.	CS	573	750
15	West.	CS	573	750
15	West.	CS	573	750
15	G.E.	KT	303	1500
20	West.	CS		730
20	West.	CS	645	715
20	West.	CS	645	715
20	West.	CS	405	675
20	West.	CS	405	675
25	West.	CS		730
25	West.	CS		715
40	G.E.	I Form K		750
40	G.E. (S. R.)	MT	347	750
40	G.E. (S. R.)	MT	347	750
50	G.E. (S. R.)	MTC	5537	750
75	G.E. (b.b.)	KT	557	750
75	G.E.	KT	559	500
75	G.E.	I Form K		500
75	G.E.	I Form K		500
75	G.E.	I Form K		500
75	G.E. (2200 v.)	I Form K		750
100	G.E.	I Form K		750
100	West.	CS		750
100	West. (2200 v.)	CS	871C	730
100	West. (2200 v.)	CS	871.52C	1460
100	West. (2200 v.)	CS	871.52C	1460
125	West. (S. R.)	CW		480
150	G.E.	I Form K		365
150	Crocker Wh.	75R		725
150	G.E. (2200 v.)	I Form K		750
150	G.E. (2200 v.)	I Form K		750
150	Allis Ch.	Slip Ring		720
150	G.E. (2200 v.)	KT b.b.	557Y	1470
200	West. (2200 v.)	CS	1013	480
200	G.E. (2200 v.)	I Form K		485
200	G.E. (S. R.)	I Form M		480
200	G.E. (S. R.)	I Form M		480
200	West. (S. R.)	CW	1011	480
200/400	G.E. 2 Sp.	K	569BS	740/1185
225	Elec. Mach. (2200 v.)	Synchronous		500
300	West. (S. R.)	CW		500
500	G.E. (2200 v.)	KT		487
500	G.E. (550 v.)	I Form K		500

MOTORS
25 Cycle—3 Phase—550 Volt

				RPM
7 —	25 HP	West.	Type CS	3/25/550/750
1 —	30 HP	West.	Type CS	3/25/550/750
1 —	60 HP	West.	Type CS	3/25/550/750
1 —	65 HP	West.	Type CS	3/25/550/500
1 —	100 HP	West.	Type CS	3/25/550/750

TRANSFORMERS

3—150 KVA West., OISC—25/1/2300/460.
3—200 KVA West., OISC—25/1/2300/460.
3—500 KVA Pitts., OISC—25/1/2300/230/460.
1—2500 KVA Gen. Elec. 60/3/22000/2300 V.

3 phase, 60 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	9445931
20	Westinghouse	CS	1200	2160500
20	Westinghouse	MS	1200	1050826
20	Westinghouse	CS	1800	1863526
20	Westinghouse	CS	1800	2695044
25	Westinghouse	MS	1800	1562026
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	126906
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	Westinghouse	MS	1800	1506800
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	General Electric	14	1800	181444
50	General Electric	KT-352	720	
50	Allis Chalmers		1800	3K28825
60	Reliance		1200	B11458
60	General Electric	I	1800	292596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121 (2200 v.)
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231 (2200 v.)
125	Westinghouse	CS	1200	2318625
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	438385
150	Westinghouse	CS	1200	4572596 (2200 v.)
150	General Electric	I-K	1200	
150	Westinghouse	CCL	720	808349 (2200 v.)
200	General Electric	I-K	900	232917 (2200 v.)
200	Westinghouse	CCL	900	919537 (2200 v.)
250	General Electric	I-K	600	2246834
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845

SLIP RING MOTORS
3 phase, 60 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
20	Westinghouse	CW644C	675	8009992
20	General Electric	MT332	545	3889010
30	Westinghouse	HF	1745	4558408
40	Westinghouse	CW748	690	4406823
250	Allis Chalmers	3 bearing	505	104390 (2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	246762

MAGNETIC CONTACTOR

1—300 H.P. Cutler Hammer. Across the Line Contactor. 3 Phase, 25 Cycle, 440 Volts.

25 CYCLE GEARHEAD MOTORS

3—10 HP. Westinghouse Frame. 364. Enclosed 1500/378 RPM.
15 HP. Master Frame 405 Enclosed 1400/418 RPM.

SPECIAL DC MOTORS

1—40 H.P. Reliance Ball Bearing Drip Proof Type T-385-T 230 V D.C. 400/1500 RPM.
1—125 H.P. Gen. Elect. 230 V. D.C. Motor. 1750 RPM.
1—40 HP Reliance Variable Speed 230 v. DC. Drip-proof Ball Bearing 400/1500 RPM.
1—45 HP. G.E.

MOTOR GENERATOR SET

200 KW Westinghouse Synchronous. Generator Type SK 201, 250 V. D.C. 800 Amps. 900 RPM Motor. 290 HP. Synchronous. 3 Phase 60 Cycle 900 RPM. Can be wound for 440 V. or 2200 V. Complete with panels, exciter, and starting equipment.

CAPACITORS

3—30 KVA Gen. Elect. Pyranol Filled Capacitors 2/60/2300 v.
3—60 KVA Gen. Elect. Pyranol Filled Capacitors 3/60/2300 v.

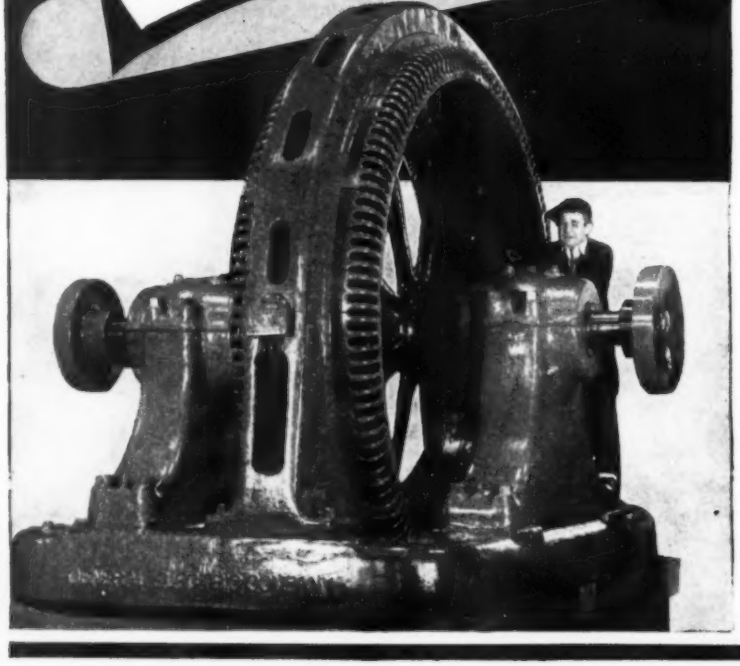
ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

CHICAGO ELECTRIC

A COMPLETE SERVICE

Guaranteed Rebuilt Power Equipment



TRANSFORMERS

Air Cooled — For Use Indoor or Outdoor

Qu.	KWA	Make	Pri.	Sec.
3	1000	Al. Ch.	13,200	480
3	100	Wtg.	240/480	120/240
3	100	Wtg.	480	240/480
3	50	Wtg.	460/230	230/115

MOTOR GENERATOR SETS

KW	Make	DC Volts	AC Volts
500	G.E.	600 syn.	3/60/2300/4000
400	G.E.	275 syn.	3/60/440
300	G.E.	250 syn.	3/60/1200
250	Wtg.	120	1/60/110/220
225	Ideal	115 syn.	3/60/2200
200	Elliott	115 syn.	3/60/480
100	G.E.	250 syn.	3/60/2200
75	Wtg.	110 syn.	3/60/2300
60	Al. Ch.	110 syn.	3/60/2300
50	Cr. Wh.	240 syn.	3/60/240
20	L. Allis	230 ind.	3/60/230
15	Heatner	220 ind.	3/60/220
14	G.E.	125 ind.	3/60/220
12½	Sprague	125 ind.	3/60/2200
8½	Al. Ch.	120 ind.	3/60/440
7½	G.E.	60 ind.	3/60/440
5	N.W.	110 ind.	3/60/220
5	Ideal	230 ind.	3/60/250
3	Lincoln	115 ind.	1/60/220
2	G.E.	6 ind.	3/60/115
2	Elec. Spec.	440 ind.	3/60/750

CHICAGO ELECTRIC CO.
1320 W. Cermak Rd. Chicago 8, Ill.

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
400	Westg.	2200	435	CW
350	Westg.	2200	900	CW
200	G.E.	220/440	1200	M-1
150	G.E.	220/440	1200	M-1
50/60	Westg.	220	1800	CW
50	Chandeysson	220/440	1800	
40-40	Westg.	220/440	1200	CW
20	Westg.	220	575	CW
15	Triumph	220	1150	
2.25	Northwestern	440	1080	HEW1½
½	Howell	220	1800	

ALTERNATING CURRENT MOTORS
3 ph. 60 cy.

H.P.	Make	Volts	R.P.M.	Type
150	Wagner	440	1800	31V
125	Al. Chal.	220 or 440	1800	AN
100	Al. Chal.	220 or 440	1800	AN
100	G.E.	220	1745	I
75	Triumph	220/440	685	B-15
75	Al. Chal.	220 or 440	1200	AN
60	West.	220/440	1800	CS
50/32	G.E.	440	800/640	
50	Chandeys'n	220/440	1800	
50	Westg.	440	1200	CS
40	Westg.	440	870	CS
30	Westg.	220/440	680	CS
25	Westg.	440	1200	CS
20	Westg.	220/440	515	CS
20	Westg.	440	860	CS
15	Westg.	440	720	CS
15	G.E.	220	900	ITC
15	Triumph	220	1150	
15	Westg.	440	1200	CS
10	Westg.	440	900	CS
10	Westg.	440	1200	CS

VARIABLE SPEED MOTORS—
230 VOLT D. C.

H.P.	Make	R.P.M.	Type
50	Westg.	256/750	SK
25	Westg.	600/1200	SK
20	Westg.	500/1500	SA
20	Westg.	750/1500	SK-110L
20	Westg.	625/1250	SA-6
15	Reliance	500/1800	
15	Westg.	875/1600	SA
10/15	Electro Dy.	600/1200	
10	Westg.	800/1600	SA
10	Cr. Wh.	690/895	CMC
10	Reliance	850/1700	
10	J.C. Curran	950/1230	
10	G.E.	625/1250	LC
10	Westg.	565/1130	S-6
10	Westg.	400/1600	SA
7½	Westg.	450/1800	SK
7½	Westg.	650/1300	
7½	Westg.	425/850	SK
7	Westg.	660/1050	S
5	West.	400/800	SK-80
4	G.E.	850/1700	LC-8
3	G.E.	400/1200	RLC-114
3	Roth	500/1000	RS

SERIES WOUND MOTORS

H.P.	Make	Volts	R.P.M.	Type
175	G.E.	230	475	MD
140	G.E.	230	410	MD
80	West.	230	490	76-A
50	G.E.	230	550	MD-106
50	Cr. Wh.	230	500	SM
35	Westg.	230	550	49D
35	Westg.	220	500	49-D
32	G.E.	230	450	801
32	Shaw	230	485	5L2E
28	Westg.	230	395	904
25	West.	230	600	MT
15	West.	220	650	
15	Cr. Wh.	220	270	SM
10	Westg.	230	750	MT-00
7½	Westg.	230	725	L
7½	Westg.	230	975	S
3½	Westg.	230	1200	L

230 VOLT DC MOTORS

H.P.	Make	R.P.M.	Type
80	Westg.	490	76-A
25	Westg.	600	SK
25	G.E.	650	MD
25	Westg.	825	SK113
20	Westg.	600	M
20	Westg.	750	SK
20	Westg.	975	S-6
20	Western Elec.	1000	E-40-M

TRANSFORMERS
1 ph. 60 cy.

Qu.	KVA	Pri. Volts	Sec. Volts	Make
1	½	110	6.12.18	Packard
1	2	1040/2080	52/104	G.E.
1	5	1040/2080	115/230	G.E.
1	5	1100/2200	122/244	G.E.
2	7½	2200/1100	440/220/110	Westg.
1	10	2300/1150	220/110	Westg.
3	18	220	19½/38½	Elec. Fur.
1	20	2300	110/230	Westg.
1	24	220/110		
2	25	440/220/110		Elec. Fur.
3	30	318/254		Pgh.
2	35	440/220/110		Elec. Fur.
6	37½	2400	480/240	G.E.
3	75	2400	240/480	G.E.
2	112.5	2400	240/480	G.E.

D.C. CLARK CONTROLLER

1—250 HP Clark Vari Time magneto controller 230 v. DC reversing, used for plugging service. Can also be used for non-reversing.

MOTOR GENERATOR SETS—
250 & 500 V. D. C.

1—80 KW 720 rpm. 250 v. G.E. Generator V-belt driven by 150 HP 1800 rpm. 220 or 440 v. 3/60 Westg. Motor.
1—33.3 KVA 1800 rpm. gen. dir. conn. to 40 HP 230 v. G.E. Mtr.
1—30 KW 250 v. DC generator direct driven by 46.5 HP 1750 rpm. 220/440 v. 3/60 Westg. Motor.
1—30 KW 250 DC 1150 rpm. Reliance Generator dir. driven by 50 HP 220 or 440 v. 3/60 motor.
2—20 KW 1700 rpm. 250 v. Westg. SK Gens. dir. driven by 30 HP 220 or 440 v. 3/60 cy. motors.
1—3 KW 1350 rpm. 250 v. type S Westg. Gen. dir. conn. by coupling to 5 HP 1350 rpm. 110 v. Westg. Mtr.

INDUSTRIAL TRUCKS

6—Automatic type LO-5 Low Lift Trucks capacity 5 ton, platform type. Equipped with towing coupler and bumper for pushing cars.
9—New 4 ton Yale & Towne model YSW Multi-Stroke Hand Lift Platform Trucks.

WRITE, WIRE OR PHONE YOUR ELECTRICAL NEEDS—SEND FOR STOCK LIST, LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

SPECIAL!
MOTOR DRIVEN WELDERS
300 and 400 ampere

GENERAL ELECTRIC — HOBART — LINCOLN
Latest type—In excellent condition

TURBO-GENERATORS—MOTORS—GENERATORS

1—Treadwell Single Drum Mine Hoist, direct driven by 200 HP Westinghouse MCOA, 230 Volt, DC motor

1—20-ton Alfred Box Crane, hand operated, 39 ft span.

1—20-ton G.E. Locomotive, 500 V DC

1—5000 KW Westinghouse Turbo-Generator, 3600 RPM, 200# press, condensing, 2300/60/3 complete.

1—800 KW Westinghouse M-G set, syn. motor, 1150 HP, 514 RPM, 13200/60/3. Generator 250 V DC with direct connected exciter.

1—50 KW Westinghouse M-G Set, 1200 RPM, 75 HP motor, 2200/60/3. Generator 125 volt DC

1—50 KW Westinghouse Turbo-Generator, 200# press. 75 HP, 7200 RPM, geared to 50 KW, 125 V DC, 1200 RPM

1—700 HP G.E. Type KF motor, 2300/60/3 1800 RPM

1—1000 HP G.E. Slip Ring Motor, 6600/60/3, 600 RPM, with controls

1—150 KW G.E. Alternator, Type ATB, Form B, .8 PF, 488/60/3 600 RPM, 3 bearing, direct connected exciter

1—300 KVA Generator set, Burke alternator, 480/60/3, 200 RPM, directed connected to Exciter and Skinner Uniflow, 150#, ISP, O-5# BP

1—3600 sq. ft. Wheeler Surface Condenser.

2—12" Lecourtney Centrifugal, bronze fitted. Pumps, 1800 RPM

1—Terry Turbine 710 HP, 3600 RPM, 145# ISP, O-60# BP, 18" x 18" centrifugal pump rated 13,000 GPM, 170' head, 1000 RPM

Heat and Power COMPANY

70 PINE ST. WHITEHALL 3-2172 **NEW YORK 5, N. Y.**

SLIP RING MOTORS
3-PH., 60 CY.

HP	Volts	Make	Speed
900	2300	G.E.	900
500	2300	G.E.	900
400	2300/440	Whse.	400
400	2300/440	G.E.	600
350	2300/440	G.E.	600
300	440	Al. Chal.	900
300	2200/440	G.E.	600
300	2200	G.E.	1800
250	2300	G.E.	600
250	440/550	G.E.	600
200	2200/440	G.E.	600
150	2200	G.E.	450
150	2200/440	G.E.	600
125	440/220	G.E.	1200
125	440/220	G.E. (Hoist)	900
100	220/440	G.E.	720
100	440/220	G.E. MTC	900
100	550	G.E.	900
100	2200	G.E.	900
100	2200	G.E.	1800
75	2200	Al. Chal. (new)	900
75	440/220	G.E. (MTC)	600
75	2200/440	G.E.	1200
50	2200/440	G.E.	600
75	550	G.E.	900
60	2200	G.E.	900
40	2200	Whse.	900
40	2200	G.E.	1200

SYNCHRONOUS MOTORS
3-PH., 60 CY.

300	440/220	Al. Ch.	600
200	2200	Whse.	900
1 10	440	Whse.	900
100	2200/550	Al. Ch.	1800
100	440/220	G.E.	360
75	440/220	G.E	720

OUTDOOR OIL CIRCUIT BREAKERS

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3—NEW 400 amp., Type FKO 227, G. E., 7500 V., outdoor type, hand-operated.
1—3000 ampere, type FK 25, General Electric, 3 pst, 600 volt.

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60 CYCLE

4—1250 kva, Al. Chal., 13800-460/230 V.
3—833 kva. Whse., 11000-2300 V.
3—500 kva, G.E., type H, form KS, 13800-230/460.
3—333 kva., G.E., 66000-480 V.
1—300 kva., Whse., 3 Ph., 13800-230 V.
3—250 kva., Whse., 13,800-460.
3—200 kva., Whse., 11000Y-2300 V.
3—200 kva., G.E., 13200-480 V.
6—200 kva., G.E., NEW PYRANOL, 2300-460 V.
3—150 kva., G.E., type HTQ, 4150-240/480 V.
3—150 kva., G.E., H-KDD 13200-2300.
3—150 kva., G.E., H-KS, 2400-240/120 V.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950V-230/115.
3—100 kva., G.E., type H-KR 6600/11430V-2300 V.
3—100 kva., G.E., H-KDD, 6600/11950-230/115 V.
3—100 kva., G.E., H-KS, 2400-240/480 V.

TURBO-GENERATOR SET

1—112½ kva., 1200 rpm., 220/440 v., 3 ph., 60 cy., G.E., conn. to Terry, 3600 rpm., non-cond. turbine, 100/150 lbs. gu.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G	IK	1200
500	440/220	G.E.	IK	900
400	2200/440	Whse.	CS	720
300	440	Whse.	CS	450
250	2200/440	G.E.	IK	600
250	2200	G.E.	IK	450
200	440/220	G.E.	IK	1200
150	440/220	G.E.	KT	720
150(3)	440/220	G.E.	KT	1200
125	440	G.E.	K	514
125	440/220	G.E.	KT	1800
125	440/220	G.E.	KT (Vert.)	1800
100	440	G.E.	IK	450
100	2200	G.E.	KT	1800
100	440	Whse.	CS	1200
100	550	Cr. Wh.		720
100	550	G.E.	KT	900
74	2200	G.E.	KT	900
50	2200	Al. Chal.		720

MOTOR GENERATOR SETS

1—75 KW, 250 V, 850 RPM, conn. to 110 HP, 440/220 V. Sq. Cage Motor.
1—50 KW, 250 V. 850 RPM, Whse. conn. to 75 HP. 440/220 V. 3 ph. 60 cy. Sq. Cage Motor.
1—50 KW, 125 V., 1200 RPM, Whse. conn. to 75 H.P. 2200/220 V.; 3 ph., 60 cy., Sq. Cage Motor.
1—35 KW, 125 V., 1800 RPM., G.E., conn. to 50 HP., 440/220 V., 60 cy., squirrel cage.

A.C. GENERATORS

1—375 kva, 514 rpm,480/240 V. G.E.
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1—200 KVA, 600 RPM, 4150/2300 V., Cr. Wh.
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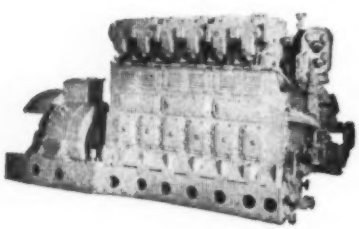

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1250 KVA GE 2300 v. Cond.
937 KVA Al. Chal. 2300 v. non-cond.
625 KVA Elliott 480 v. non-cond.
625 KVA GE 2300 v. Cond.
625 KVA Wghse. 480 v. (bleeder)
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750 HP Sterling, 250#
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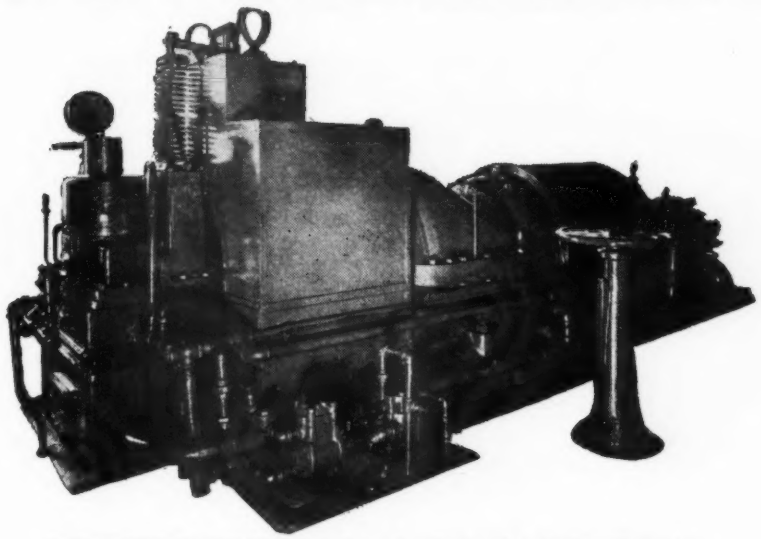

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2500—KVA-G.E. Surf.Cond. 200# 2300-V
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1565—KVA-G.E. Surf.Cond. 150# 2300-V
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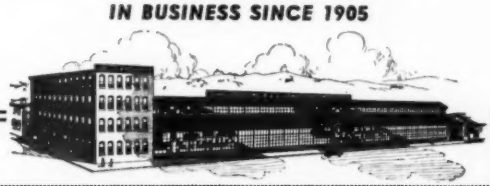

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38'10½" Span D. C.
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Manning, Maxwell, & Moore 47'4" Span
Shaw 36' Span
Champion 37'6" Span
American 70' Span
American 47'4" Span
6-Ton
P&H 77' Span
American 77' Span
7½-Ton
Shepard 36' Span
10-Ton
Shaw 68' Span
Shaw 73' Span
P&H 30' Span
P&H 87'6" Span
P&H 80' Span
Northern 71'10½" Span
Northern 60' Span
Morgan 55'6" Span
Morgan 39'5" Span
Morgan 52'3" Span
Milwaukee 66'9" Span
McGill 85' Span
Lane 50' Span
Ensco 75' Span
Dominion 35' Span
Cleveland 38'1½" Span
Cleveland 50' Span
Alliance 71'10½" Span
Alliance 58'9" Span
Albany 60' Span
15-Ton
Whiting 71'10½" Span
Northern 53' Span
Erie 60' Span
Chesapeake 55'6" Span
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20-Ton
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P&H 51'4" Span
Northern 60' Span
Morgan 60' Span
Cleveland 65' Span
25-Ton
Whiting 106' Span
Tysaman 60' Span
P&H 70' Span
Morgan 52'3" Span
Cleveland 106' Span
Case 63' Span
Bedford 59' Span
30-Ton
Whiting 80' Span
P&H 80' Span
P&H 60' Span
Morgan 30' Span
Case 41' Span
35-Ton
Bedford 50' Span
Northern 22' Span
50-Ton
Shaw 95' Span
Shaw 69'10" Span
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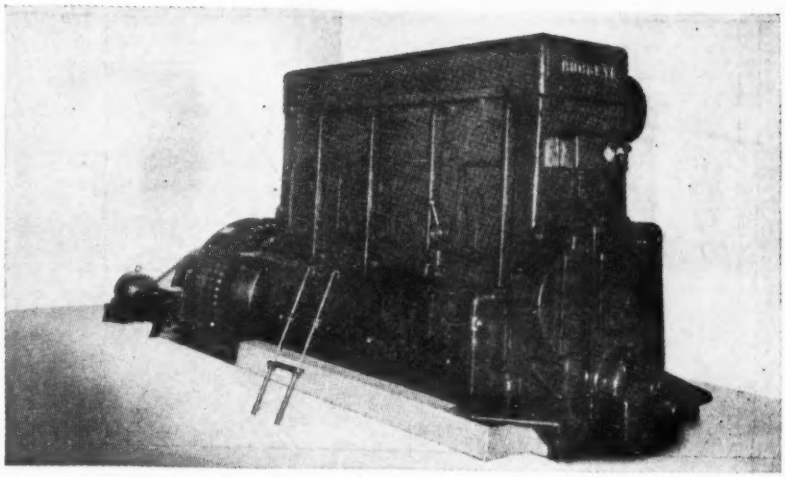

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80	220/440	Cr. Wh.		1200	25	220	G.E.	KT	1200
75	220/440	G.E.	KT	1200	15	220/440	Whse.	CS	1200
66	220/440	G.E.	KT	1200	10	220/440	G.E.	KT	1200
60	220/440	G.E.	KT	1200	5	220/440	G.E.	KG	900
50	220	G.E.	KT	900	2	220/440	Lima	L	1800
40	440	Whse.	CW	900	1	220/440	G.E.	KL	1200

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1—Penn Centrifugal 1000 GPM—85' head, direct conn. 30 HP Cr. Wh. 115 Volt D.C. mtr.
1—Wr. Austin Co. oil separator 20" inlet & outlet.
1—Harrison Safety Boiler Works Cosh. open heater, V notch recording, 40,000 lbs. per hr. cap.
1—Ames hor. Unaflow Crocker Wheeler D.C., 115 Volt generator 50 KW—275 RPM.
1—30 KW Harr.—325 RPM, 230 V. D.C., gen. set.
1—15 HP Cr. Wh. D.C. motor 115 V. 800 RPM.
1—60 HP Cr. Wh. D.C. motor 115 V. 1200 RPM.
1—2 HP Cr. Wh. D.C. motor 115 V. 1550 RPM.
1—5 HP Cr. Wh. D.C. motor, 115 V. 1200 RPM.
1—60 HP Cr. Wh. D.C. mtr. 115 V. 300 RPM dble.

FS-150, Power, 330 W. 42d St., New York 18, N. Y.

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ELECTRIC—STEAM—GASOLINE DRIVEN.
All Makes — Capacities — Pressures.
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STANDARD EQUIPMENT — UP TO 200 H.P.
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SPENCER—INGERSOLL RAND—ALLEN BILLMYRE. For Heat Treating — Brazing Furnaces — Smelting — Vacuum Duty Etc.

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BOILER

250-hp Babcock-Wilcox horizontal water tube boiler, 42 inches x 11 feet 6 inches, riveted steel drum; 130 three-inch tubes; 150-lb. working pressure. Fully equipped with Riley-Jones type S.P. side-dump hopper feed stoker, low water control and draft gauge. Installation includes 100-foot steel stack, 36-inches in diameter car-to-bin and bin-to-stoker conveyors as well as all necessary electrical equipment for complete operation.

All in excellent working condition. Having installed gas-oil boilers, we will sell as-is, where-is, at attractive price.

SHOPPING NEWS

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IN STOCK!

GENERATORS

One 250 K.V.A. and one 300 K.V.A. Crocker Wheeler Generators direct connected to Skinner Tandem compound engines—480 Volts—3 phase 60 cycle, switchboard, instruments, piping.

One 300 K.W. General Electric Generator, 2300 v., 3 ph., 60 cy., direct connected to Curtis Steam Turbine, 175 lbs. pres.—3600 R.P.M. with 15 K.W. G.E. direct connected exciter.

ELECTRIC MOTORS

Induction Type—220 V.—2 Ph.—60 Cy.

1—5 H.P. Burke—Type EB 5—1130 R.P.M.
1—5 H.P. Burke—Type EB 75—900 R.P.M.
1—7½ H.P. R&M—TYPE K—850 R.P.M.
1—10 H.P. Burke—Type EM 1.2—900 R.P.M.
2—20 H.P. Burke—Type EM 3—1200 R.P.M.
1—20 H.P. Crocker Wheeler—1170 R.P.M.
1—35 H.P. Burke—Type EM—4.5—900 R.P.M.
1—50 H.P. Burke—Type EM—4.5—1200 R.P.M.
1—150 H.P. West—Type CW—1765 R.P.M.
1—7½ H.P. totally enclosed—fan cooled—1200 R.P.M.

PUMPS

1—Vertical Centrifugal Pump, 3" suction, 3" discharge, all iron, 25 g.p.m.—52' head, complete with 5 H.P. Louis Allis Vertical Explosion Proof Motor, 220-440 volts, 3 phase, 60 cycle, 1750 r.p.m.

One American Well 2 stage Centrifugal pump direct connected to 30 H.P. G.E. motor, 220 v., 3 ph., 60 cy., 1750 R.P.M. 200 ft. head complete with magnetic starter and safety switch.

DEEP WELL PUMPS

1—American Well Works; capacity 165 g.p.m. with 15 H.P. Motors; Current 220 volts, 3 phase, 60 cycle.

FEED WATER PUMPS

1—Warren Duplex—Size 10" x 7" x 12" Brass Lined & Fitted—Stainless Piston Rods
1—Worthington Duplex—Size 9" x 5¼" x 10" Stainless Piston Rods

FEED WATER HEATERS

One Goubert feed water heater with brass tube—330 sq. ft. heating surface.
One Cochrane feed water heater, 54" dia. x 48" long—1500 H.P. capacity.

BOILERS

One 444 H.P. Union Iron Works, water tube steam boiler 200 lb. working pressure, pulverized coal or oil fired.

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40 H.P. Nagle vertical steam engine, Class F. 12" cylinder, 12" stroke, flywheel 54" x 12½".

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1—1250 KW General Electric Turbo-Generator, Type ATB, Form HT, 3600 RPM, direct-connected exciter, Wheeler Jet Condenser.

1—2000 KW General Electric Turbo-Generator, 180 lb. pressure, 3600 RPM Generator, Type ATB, 600 Volt AC, 2403 Amp. with Westinghouse-LeBlanc Jet Condenser.

1—1500 KW Westinghouse Turbo Generator with Surface Condenser 4200 sq. ft.

BOILERS

3—400 HP Casey Hedges Water Tube Boilers.

1—500 HP Casey Hedges Water Tube Boiler. Foster Superheater. These boilers are oil fired, system complete, automatic draft control equipment, etc.

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1—Snow 8MGD C&FW cr. Com. Opp. Type Cond. 26x54x17x36, with waterworks type condenser.
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1—Allis-Chal. 4 mgd. cr. com. cond. Size 12x28x13x24. All find cond.
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Birch Valves for all types of reciprocating pumps.

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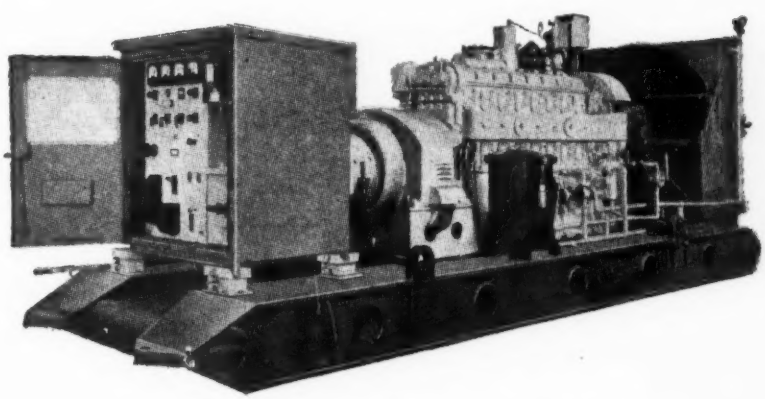

HP	ENGINES	MODEL	KVA	RPM	YEAR
8—1600	General Motors	16-278A	1250	720	1944
2— 750	Cooper Bessemer	FS 8	625	1200	NEW
4— 720	Alco	6B 25	625	600	1945
6— 450	Cooper Bessemer	FS 8	375	600	NEW
2— 450	General Motors	6-278A	375	600	NEW
1— 380	Chicago Pneumatic	89	300	720	NEW
1— 375	Alco	5B25	372	360	1938
1— 375	McIntosh Seymour	3B32	372	360	1931
1— 375	Fairbanks	32E	300	300	1936
1— 360	Fairbanks	32VA	300	257	1928
1— 300	General Motors	8-268A	250	900	NEW

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Port Washington Long Island, N. Y.

Roslyn 1600

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NEW • ELECTRIC • STEAM • AIR EQUIPMENT
Thousands of Items A/C or D/C from 1 to 500 K.W.

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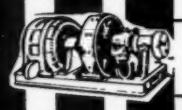
Your Requirements



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ESTABLISHED 1904

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Thousands of Items - A/C or D/C. From 1 to 500 KW

2—4000 KVA. 60 Cy. 3 PH. TURBO WITH SURFACE COND.
1—3125 Kva. G.E. Turbo 230 V. 60 Cy. 3 ph.
100 KW. 550 V. 3600 Rev. 60 CY. 3 PH. turbo with exciter.
1500 CFM 2 STAGE AIR COMP. 275 HP. 60 CY. 2200 V. Syn. Motor Dr.
2—Cent. Pumps 4166 GPM, 162' Head, 1750 Rev.
1—36000 GPM. 27' or 25000 GPM 40' Hd. 285 Rev. Cent. Pump.
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1500 and 2500 HP. 60 CY. A.C. Motors, 435 and 257 Rev.

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NEW INSULATED MAGNET WIRE

Size	Description	Approx. Weight
.072" (#13 AWG)	Triple Cotton Cov. Rd.	2354 #
.072" (#13 AWG)	Asbestos Insulated Reels	135 #
.051" x .114"	Dbl. Glass Cov. Rect.	615 #
.064" x .325"	Asbestos Insulated Rect.	130 #
.064" x .365"	Asbestos Insulated Rect.	503 #
.035" x .155"	Double Vitreous	1618 #
.110" x .185"	Double Vitreous	217 #
#17 AWG	Dbl. Cot. Cov. Enamel	5661 #
#15 AWG (.057")	Enameled with One Wrap of Manila Rope Paper	10616 #
.032" x .365"	Double Glass Covered	3853 #
.058" x .118"	NOT INSULATED	4306 #

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Diesel engine generating units 50 H.P. and up; gas engines with or without generators, 50 H.P. and up; steam engine generating units 62 KW to 400 KW; generators and turbines.
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450 & 600 lb. Turbo-Generators, Non-Cond.
450 & 600 lb. Turb.-Gens. Cond., Bleed Type
2—770 HP B&W Co. Stirling 200# Boilers, Superheat—Reconditioned.
1—612 HP B&W Co. Stirling 200# Boilers—Ready to Ship
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Various Makes, Boilers 150 to 2000 HP.
Turbo-Generators 100 KW to 12500 KW—Condensing & Non Cond.

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FOR SALE
DIESEL ENGINE
1—Vertical Diesel Engine Type D4 300 HP 4 Cylinder, direct connected to General Electric Type LDR-8 direct current Generator 200 KW 327 RPM L 250 V.

EXHAUST TEMPERATURE INDICATOR
1—Alnor Exhaust Temperature Indicator with 4-point switch and 4 couples Mfd. by Worthington Pump and Machinery Corp. Mfrs. No. V0862. Installed 1933. In Excellent condition and is in operation now.

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DIESEL GENERATOR UNIT
1500 H.P.—1250 KVA
Nelseco — General Electric
Modern, Supercharged, Bosch Injection
3/60/2400, 300 RPM, All Accessories, Complete
Immediate Stock Delivery Rebuilt
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1—72'x309' Steel Frame Building
1—40,000 Gallon Steel Tank & Tower
1—625 KVA, 220 V. Gen. D/C Corliss Eng.
1—250 HP. 440 V. GE Late Type Slip Rg.
1—7½ Ton, 78' Span, AC O.E.T. Crane
1—66"x14' 125# H.R.T. Boiler
100—1/3 HP. Single Ph. Capacitor Ind. Motors
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ALTERNATORS, ALL FREQUENCIES
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ALL SIZES
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3 ph. 60 cy. A.C. Motors
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125 Volts D.C. Motors
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Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES

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STEAM PUMPS—Duplex - Simplex. Reconditioned and guaranteed.

BOILERS—stacks—Engine Generators—condensers.

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New & Guaranteed Rebuilts
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Erie City Slide Valve 200 KW, 2 Phase, 60 Cycle, 120/240 Volts, type AQB. Complete with switchboard.

Quick Sale $1850.00 on foundation.

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300 KW 250V. 435 KW 2 hrs 720RPM General Electric type MPC Generator to a 3 phase, 60 cycle syn. motor with panels excellent condition

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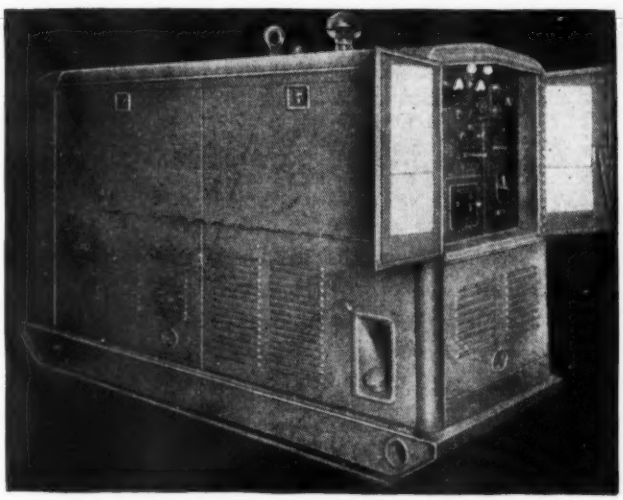

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RADIATOR COOLED — SKID MOUNTED

AC ALL SIZES 3 KW TO 100 KW **DC**

SPECIAL PURCHASE BARGAIN

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21 60 HP, 900 RPM, 440 volt, 3 phase, 60 cycle, new Reliance ball bearing motors. $601.00, each, net, f.o.b. Minneapolis.

5 Four speed motors, 5 HP, Frame 324, Type K, Model 5K324A-1398, 440 volt, 60 cycle, 3 phase, speed full load 1710—1115—870—565, Class Two, Group E, totally enclosed, 55 Deg. C. rise, offered new at 20% off list.

Complete stock of explosion proof reflectors, switches, fittings and miscellaneous items, all at bargain prices.

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ELECTRICAL EQUIPMENT COAST TO COAST

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1 Chuse Engine, #1003, 11 x 12 Piston and Stroke, 277 R P M, 4 Valves—

which is directly connected to

1 Westinghouse Alternator AC #1205098 2 Phase, 75 KVA, 200 V, 170 Amp, 60 Cycle—277 R P M

and

1 Westinghouse Exciter DC #1205053 Type SK #130, 7 KW, 125 V, 56 Amp. 277 R P M

also

A one section slate panel switch board size 36 x 66".

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20 HP GEARHEAD MOTORS

Master, Type PA, Frame 365, Style 114413, 3 phase, 60 cycle 220/440 volts, 420 R.P.M. Totally Enclosed Fan Cooled.

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1—680 KW NORDBERG UNAFLOW

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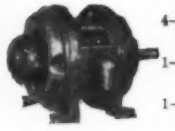

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Sq. Cage—220/440 V. 60 Cy. 3 ph.

Qu.	HP	Make	Type	Speed
2	50	G.E.	KT-327	1800
2	100	G.E.	IK	1800
1	150	West.	CS	1800

Slip Ring—220/440 V. 60 Cy. 3 ph.

1	40	West.	CW	720
1	50	G.E.	I-M	900
1	60	G.E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200

D. C. Variable Speed 230 V.

1	15	West.	SK	400/1600
1	25	West.	SK	440/1200
1	50	West.	SK	500/1500
1	50	G.E.	CD	400/1600

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Cylinders 28"x32" 150 Revolutions Shop No. 1575—condensing or non condensing, worthing jet condenser, steam receiver sufficient in size to take care of steam engine. Generator size 2300 volts, 600 KW (General Electric) Exciter direct connected to Generator.

Will sell for $7,500.00 on foundation

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Highland, Illinois

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● We have always available a complete range of HI-GRADE rebuilt transformers. All units are carefully tested in accordance with A.I.E.E. specifications and carry a one year guarantee.

All work is done by the same organization and under the same rigid controls as the nationally known Gregory HI-GRADE line of new transformers.

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TO HELP YOU . . .

find equipment you need

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600 HP B&W Boiler—Taylor Underfeed Stoker—3 Horizontal Drums—Sectional Headers—294 4" Tubes New 1945—Hartford Approved 203 lbs. Pressure. Now operating.

Immediate Delivery.

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One (1) 15" x 15" double cylinder, double acting, horizontal Vilter Ammonia Compressor, rated at 278 tons. Driven by a 375 HP, 440 Volt, 3 phase, 25 cycle Electric Machinery Company Synchronous Motor, 214 RPM.

CHR. HEURICH BREWING CO.
26th & D Sts., N.W.,
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NEW D.C. MOTORS

IN ORIGINAL CRATES—IMMEDIATE DELIVERY

Quan	HP	RPM	Volts	Make
5	1¼	1150	230	G.E.
9	1½	1150	230	G.E.
9	1½	1750	115	G.E.
14	1½	3450	115	West.
34	3	1750	230	G.E.
34	3	1150	230	G.E.
121	5	1400/1750	115	Star
56	5	1400/1750	230	Star
33	5	1750	230	G.E.
28	5	1750/1850/2050	230	Reliance
15	5	1200	230	G.E.
8	5	900/1200	230	Star
6	5	900	115	G.E.
5	7½	900/1200	115	Star
1	7½	900/1200	230	Star
26	7½	1400/1750	230	Star
34	7½	1750	230	G.E.
12	7½	1750	230	Reliance
1	10	600	115	West.
13	10	850	230	West.
1	10	1150	230	Star
2	10	900/1200	115	Star
98	10	1400/1750	115	Star
10	15	1400/1750	230	Star
9	15	1750	230	G.E.
2	15	900/1200	115	Star
23	15	1400/1750	115	Star
2	20	1200	230	G.E.
11	20	1400/1750	115	Star
8	20	1400/1750	230	Star
6	25	1750	230	G.E.
4	25	1400/1750	115	Star
4	25/30	900/1200	115	Star

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SIZE 10' x 15'

Complete with motor, Reeves drive and all other necessary equipment.

This unit is in perfect condition and is for sale at a bargain price.

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3—883 Kva—2400—240/120
2—400 Kva. Pittsburgh, 25 cy. 1 ph. 6600—440/460
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6—75 Kva—2300—230/115
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New or used. All types and sizes

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TRANSFORMER SPECIALTIES
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WURTH for "WORTH"!

A.C. GENERATORS 3 PHASE—1 PHASE 15 TO 62½ KVA

LARGEST STOCK OF A.C. AND D.C. MOTORS FROM 5 TO 200 H.P.
D.C. MOTOR GENERATOR SETS TO 75 KW • HIGH CYCLE GENERATORS
Send For Our Latest Stock List

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Motors, Generators, Alternators, Frequency Changers.
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For Sale **1000 KW 250V-D.C. ENGINE GENERATOR SET**
FS-155, Power
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1—New steel stack,

57" diameter x 100' high with breeching, double setting with 12' centers. Will send print.

THE ACME FOUNDRY & MACHINE COMPANY
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FOR SALE

Stokol hydraulic feed stoker.

80 h.p. boiler. Excellent condition. Can be inspected any time.

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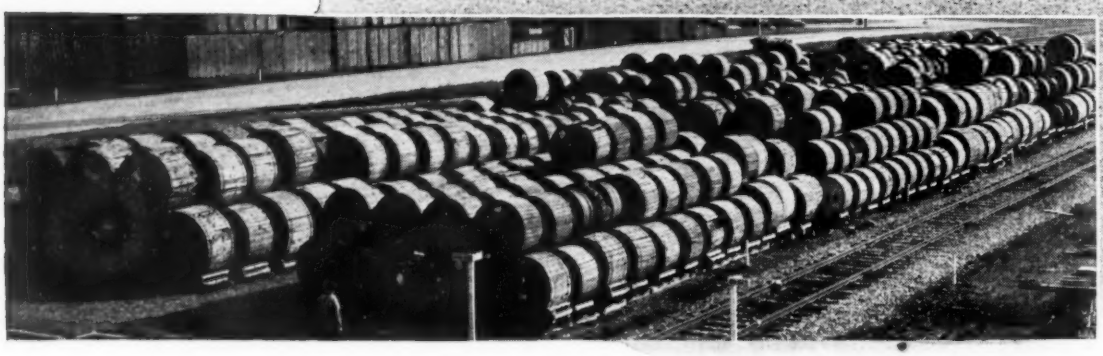
For Quick Sale . . .

ELECTRIC WIRE AND CABLE



The War Assets Administration has a large inventory of government surplus Wire and Cable. It was made by leading manufacturers for war purposes under close supervision to exact technical specifications.

Some of the types and sizes are standard and conform to underwriters' code. Others, while non-standard, are adaptable to a wide variety of uses.

Some suitable applications are circuits for:

power and light, radio, telephone and signalling,
ignition and control, plus battery charging,
instrument and switchboard wiring, welding, etc.

Priced far below its acquisition cost, it will appeal to construction contractors, oil well and mine operators, and ship builders. Ingenious engineers will find many ways to use this material to their advantage.

Get in touch with your nearest Regional Office of the War Assets Administration. Special technical personnel will be happy to give you data on specific types and sizes or arrange for your inspection of the material.

WAR ASSETS ADMINISTRATION

OFFICES LISTED BELOW ARE TEMPORARILY IN RECONSTRUCTION FINANCE CORPORATION AGENCIES

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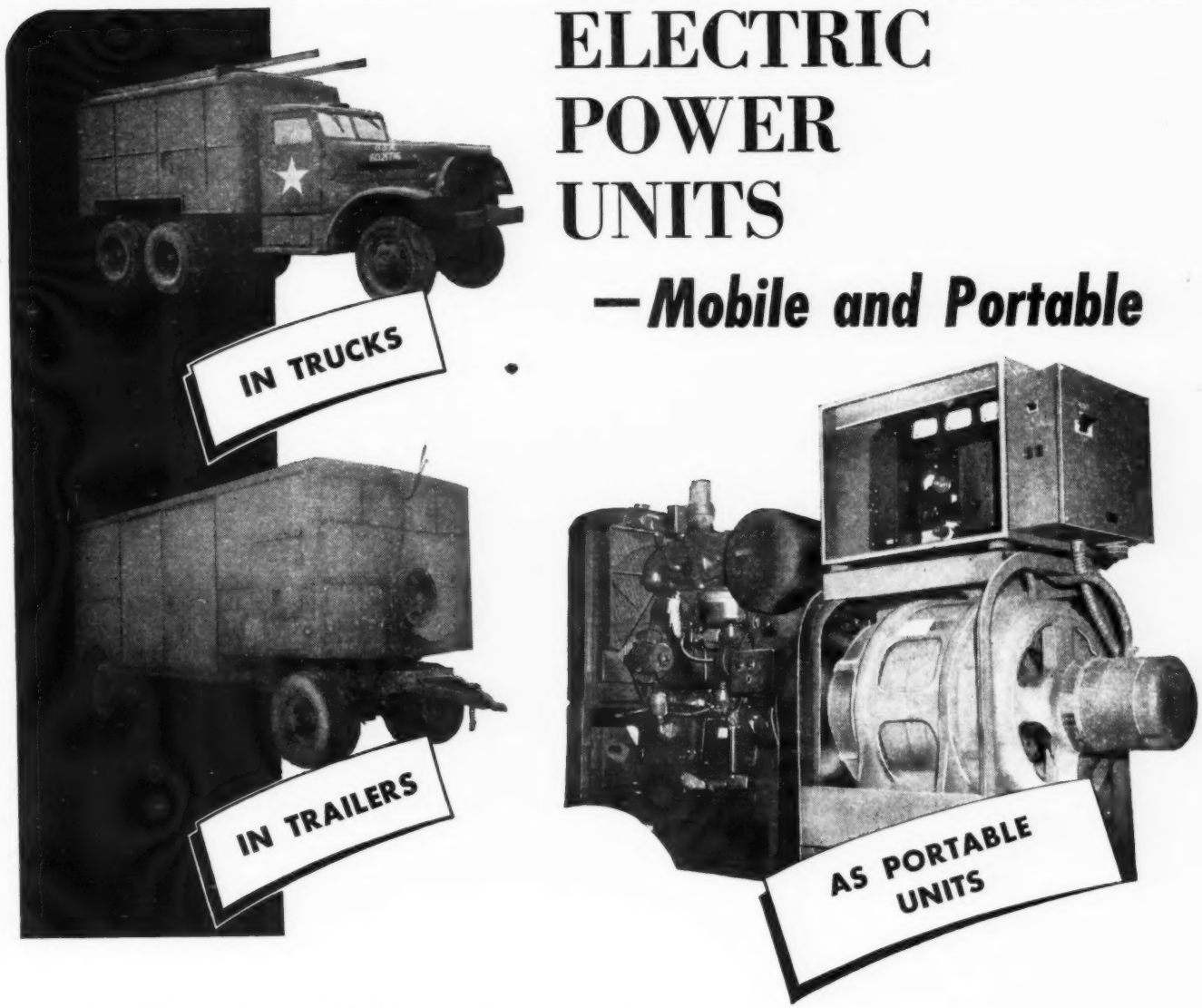
319-2

VETERANS OF WORLD WAR II: To help you purchase surplus property, a veterans' unit has been established in each WAA office

ELECTRIC POWER UNITS
—Mobile and Portable



The War Assets Administration has priced for *immediate sale* 25 KVA gasoline-powered AC Generators—120 volts, single phase, 60 cycles—

- in trucks
- in trailers
- as portable units

The mobile equipment is used but in good condition. Many separate units are unused, some are used but all are in good condition. They should be of particular interest to construction contractors and all users of electric power in the field.

Write or phone your nearest War Assets Administration Regional Office for full information.

- **IN TRUCKS $5487 or less***
- **IN TRAILERS 3017 or less***
- **PORTABLE 1987 or less***

*(*depending on condition)*

F.O.B. Baltimore, Md. San Francisco, Cal. or Cleveland, O.

Trucks and Trailers in Baltimore only.

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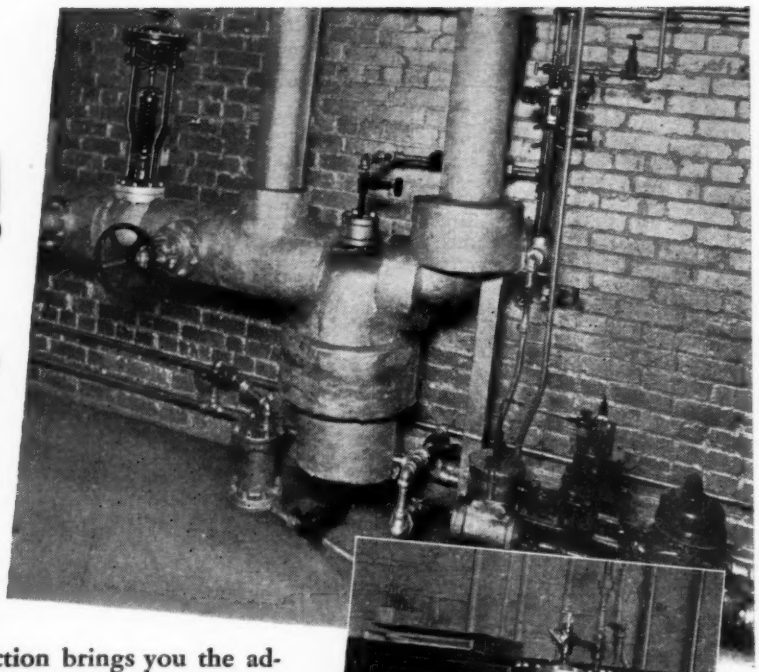
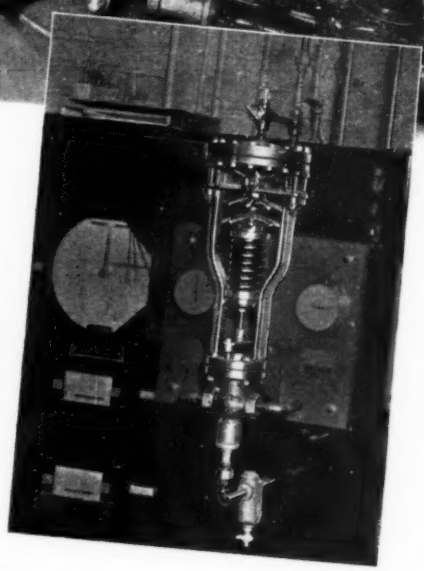
Hold temperature and pressure *on the line!*

...with safe, accurate Swartwout Reducing and Desuperheating Equipment





● A reducing and desuperheating station completely designed by Swartwout to handle your entire job of temperature and pressure reduction brings you the advantage of properly related equipment working smoothly together. You'll find it means much to your sense of security to have the dependable guaranteed control you get with Swartwout Equipment.

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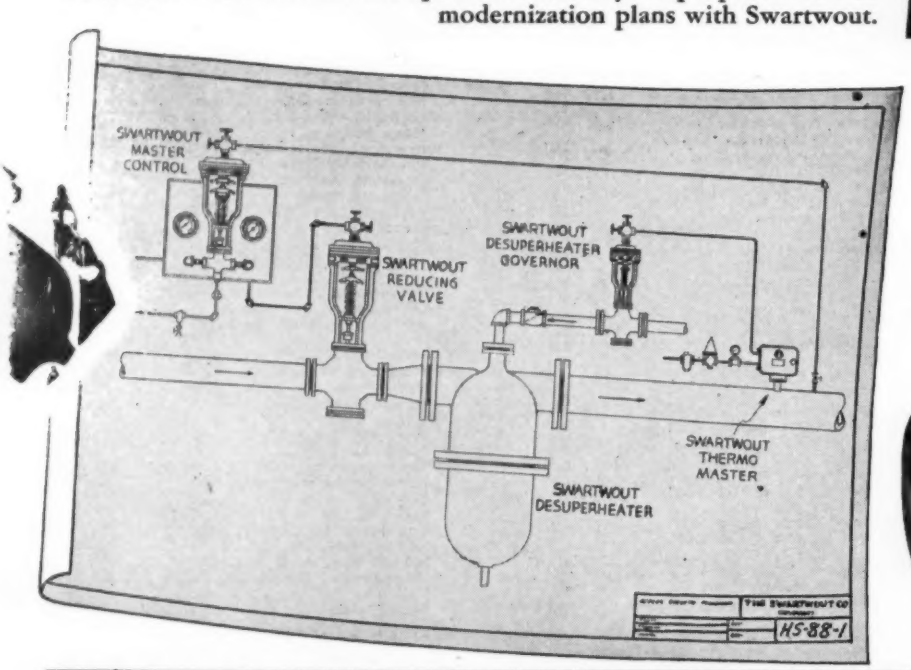
Hundreds of users bank on their Swartwout Reducing and Desuperheating Stations to hold reduced steam temperatures and pressures *on the line*—for safe efficient operation. Check your proposed new or modernization plans with Swartwout.



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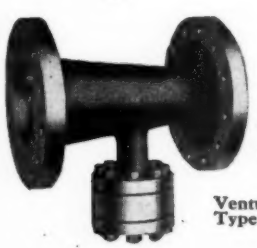

Carburetor Type

Venturi Type

Swartwout POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio

GRINNELL PIPE HANGERS AND SUPPORTS

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Not only do correctly engineered hangers save you valuable installation time, but they also provide such definite advantages as • *Easy Adjustment during and after pipe erection* • *Full Provision for thermal movement where necessary* • *Easy Maintenance* • *Compliance with all piping code requirements.*

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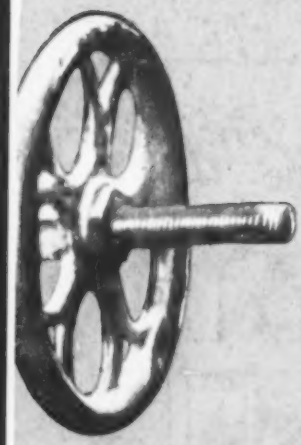
FOUNDED 1850

WHENEVER **PIPING** IS INVOLVED



"No trouble at all...

when you control boiler feedwater!"

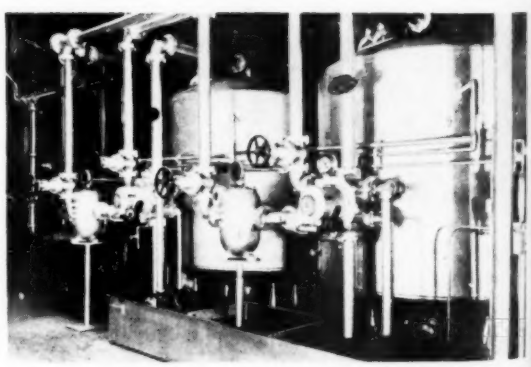
How Permutit helps prevent boiler scale and corrosion

There's no chance for impurities in feedwater to cause scaling, corrosion of boilers and steamlines—and even more serious trouble—if a plant is Permutit* protected. Permutit *removes* these impurities before the water enters the boilers!

Manufacturers of water conditioning equipment for over 30 years, Permutit provides *every* process for control of water quality—Zeo-Karb Water Softeners (illustrated), Hot and Cold Lime Soda Softeners, Deaerating Heaters as well as Continuous Blowoff and Demineralizers that deliver a low-cost substitute for evaporated water.

It's no trouble at all to keep boilers *clean as new metal*—with Permutit Water Conditioning. Write, outlining your water problem, to The Permutit Company, Dept. P7, 330 West 42nd Street, New York 18, N. Y. or Permutit Co. of Canada, Ltd., Montreal.

*Trademark Reg. U. S. Pat. Off.



PERMUTIT ZEO-KARB* H WATER CONDITIONER removes both hardness and bicarbonates from water. Effluent contains no incrustants, is reduced in total solids and alkalinity. Alkalinity can be adjusted by mixing effluents from a Zeo-Karb H Unit and a sodium zeolite unit.

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Manufacturers of ALL types of water treatment equipment

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